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**RESULTS OF A KAKAPO SEARCH IN SOUTHERN
STEWART ISLAND, DECEMBER 1984-MARCH 1985**

by

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ABSTRACT

A search of much of southern Stewart Island was made in December 1984 -March 1985, principally to locate kakapo feeding sign and track-and-bowl systems, and to listen for booming male kakapo. In addition, a general survey was carried out for birds and lizards in the 222 one thousand metre grid squares visited. Evidence was found of 25 adult male kakapo, and it was determined that the kakapo population on Stewart Island numbered 45 birds (25 male, 16 female, 4 immatures). Kakapo were distributed east and west of the Tin Range. On the western side sign was found from the Basin Creek catchment north to Deceit Peaks; while east of the range kakapo distribution extended northeast of the central study area to Kirklands Hill and the Toitoi River. In addition, a few birds were probably living on and about Mt Rakeahua.

Forty-three bird species were encountered during the survey. In descending order of percentage occurrence in the grid squares, the bellbird, Stewart Island brown kiwi, yellow-breasted tit and redpoll were the species most frequently found. Two species of lizard were captured including three specimens of the harlequin gecko within its previously recorded range. A third species was tentatively identified from sightings.

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INTRODUCTION

On 14 January 1977, a Wildlife Service expedition began a search for rare birds in southern Stewart Island. The expedition was sponsored by the National Provident Fund and consisted of four two-person teams. Within two days of starting the search, fresh sign of kakapo was found and so the teams concentrated on determining the extent of kakapo distribution. By 8 February about 5000 ha had been searched, mainly east of the Tin Range and evidence of 31 kakapo had been found (R.J. Nilsson, W/S file 25/3/4).

Following this discovery and with the prospect that females were present, further searches were made in July-August 1977, January-February 1978, July-August 1978, July 1979 and January 1981 to establish the range of the kakapo. These searches showed that the population was concentrated in an area of 6000-8000 ha, bounded on the west by the Tin Range and Pegasus Creek and to the north by the ridge between the Kopeka and Seal Creek catchments. The coast formed the southern and eastern boundaries, although no kakapo were considered to inhabit the coastal fringe of forest at the time. The exception was near Seal Creek Bay, where in 1977 some occupied track-and-bowl systems were found within a kilometre of the coast (Russ & Anderson 1977). Outside this region kakapo were evident about the summit of Mt Rakeahua, near Deceit Peaks and at Trig O.

As a result of the surveys and by noting the occupancy of track-and-bowl systems in January 1981, it was variously estimated that the island's total population of kakapo was less than 100 (Merton 1982) or 100-200 birds (Best 1982). However, during 1981-1983 two factors resulted in fewer kakapo being present than previously. During 1981, at least in the

environs of Seal Creek, and the Robertson River and its tributaries, many kakapo were killed by cats. Annual mortality rates of 56% were calculated based on the monthly survival of radio-tagged birds during September 1980 to February 1982 (Best 1982). Subsequently, some birds were killed by cats, but cat-control efforts helped to reduce the rate of predation.

It was apparent that the population could not withstand such a high level of predation for very long. Therefore, it was decided to transfer some kakapo to a predator-free site. Using muzzled dogs in 1982 searchers found 18 birds (7 females and 11 males) and transferred them to Little Barrier Island. In 1980-1981, four birds were taken from Stewart Island to Maud Island, from which three (2 females and 1 male) were moved to Little Barrier Island in 1982.

Therefore, a significant proportion of the estimated 100-200 birds had either been killed or removed from Stewart Island during 1980-1983. By October 1984 only three females and 12 males were known to remain there. Nevertheless, for the Wildlife Service to decide upon the most appropriate management for the species, it was essential to have up-to-date information on the numbers and distribution of male and female kakapo remaining.

This report describes a re-survey of possible habitat for kakapo on Stewart Island made between December 1984 and March 1985. In addition, the results of a survey for other bird species and lizards the searchers found in each 1000 m grid square are described.

AIMS

1. To determine the presence/absence of kakapo by searching for sign and listening for calls outside the central study area, Scollay's Flat (Figure 1), particularly where past surveys had revealed the presence of kakapo;
2. to provide general survey information about all bird species seen or heard in each 1000-metre grid square entered (NZMS 260 C49, D49 & C50, D50) (Figures 11 & 12); and
3. to provide general survey information about all lizards seen.

METHODS

A team of two to four people operated from a hut or tents transported to a new location by helicopter at fortnightly intervals. During each fortnight, when the weather permitted, the team searched as widely as possible within a day's walk of the hut. Occasionally, they camped out to check more distant areas. Areas searched were mapped (see Figure 4).

A. Kakapo sign

The main means of detecting the use of an area by kakapo was to search for the various types of sign they leave. Males form track-and-bowl systems, from which they call (or "boom") in summer. The bowls are depressions in the soil about 50 mm deep and 450 mm wide. Usually there are two or more bowls interconnected by tracks clipped of vegetation. These systems are distinctive and often can be recognised several years after they were last used. Characteristically, they are situated on sparsely-vegetated ridges and hill-tops.

Kakapo faeces vary in shape, but typically they are of a firm consistency with the material coiled on itself. Since the birds eat only vegetable matter, fresh faeces have a herby smell. Thus, by their shape and smell, kakapo faeces, unless very old, can usually be distinguished from those of other animals with similar-sized faeces, possum, deer and cat on Stewart Island.

Feeding sign can usually be located in an area occupied by a kakapo. The most characteristic feeding results from their habit of thoroughly chewing fibrous material and discarding the fibre as compact pellets or 'chews'. The chews are left hanging on plants or are discarded about the eaten plant. Possums and deer also discard chews when feeding on fibrous plants. However, kakapo chews can usually be recognised because they are tightly compressed, and beak impressions are evident when leaves have been chewed. As well, kakapo sometimes leave crescent-shaped chews, 15 mm x 10 mm, which may show an impression of the grooved inner surface of the upper mandible.

Kakapo grub the roots, rhizomes and bulbs of many plant species. At freshly grubbed sites, bill impressions are often evident at the face of the excavated area. While other types of kakapo feeding sign are present on Stewart Island, they can be confused with that of deer, possum and rat. In such situations it was attributed to the bird only when it occurred with other kakapo sign.

Each kakapo sign was described under the following headings on a data sheet: date, grid reference, habitat type (using the definitions given by Best (1984)), type of sign, and an estimate of the age of the sign (0-2 days, about a week, more than a week).

B. Booming

During the survey period the male kakapo boomed intensively and the females nested. The males occupied their track-and-bowl systems most nights from late December to late March. They boomed for most of the night, giving a series of booms every few minutes. Each male generally uses the same track-and-bowl system for a booming season, and, probably, for life. Therefore, by counting the number of occupied systems in a breeding season we obtained a count of the number of adult males present. On still nights or when the listener is downwind of a calling male during light winds, booming can be heard a kilometre or more from a system. Thus, listening for booming provided an additional means of determining whether male kakapo were present in the vicinity. When booming was heard the following information was recorded: date, time, weather conditions, and direction of sound.

C. Bird and Lizard Survey

While searching for kakapo sign the team made records of other bird species and of lizards. For each 1000-metre grid square on the NZMS 260 maps of southern Stewart Island (C 49, D 49 Mt Allen; C 50, D 50 South Cape) that was visited, a list of all species encountered was recorded. At least one, and up to five lists, were completed for each square entered. The time spent in each square varied markedly, from 30 minutes for remote squares to several days in the case of squares in which camps were situated. O'Donnell and Dilks (in prep.) determined, from comparing four methods of compiling forest-bird species lists for grid squares in South Westland, that a transect count lasting about 40 minutes resulted in most species in a square being recorded. Because at least 40 minutes were spent in most southern Stewart Island squares entered, the results are a reliable indication of the presence of each species of

forests and alpine tops in a square. However, the apparent absence of a species from a visited square, particularly uncommon or mobile species, cannot be taken to indicate a real absence of that species.

Lizards found were tentatively identified from the key in Towns (1985). Dr Towns provided lizard distribution cards, one of which was filled in for each capture.

D. Vegetation

The vegetation type inhabited by each species in a square was usually recorded. Quantitative vegetation descriptions were not made of the forest in each grid square, and so no information about the frequency of occurrence of each vegetation type in the search area is available. The region contains a mosaic of forest, scrub and moor land, and the structure and composition of the vegetation is influenced by altitude, soil type, watertable, exposure to wind, and past history of fires and mining (Wilson 1982). The seven broad vegetation types of Best (1984) were used to classify the vegetation in which birds were encountered.

Coastal scrub - A narrow (< 50 m) belt of woody vegetation immediately adjacent to the coast, but penetrating further inland on exposed sites. The tight, umbrella-like canopy is dominated by *Olearia angustifolia* and *Senecio reinoldii*.

Podocarp-hardwood forest - Moderately open canopy up to 20 m high comprising mainly rimu (*Dacrydium cupressinum*), miro (*Prumnopitys ferruginea*), rata (*Metrosideros umbellata*) and kamahi (*Weinmannia racemosa*). It occurs predominantly within one kilometre of the coast, but is found inland along the main river courses and in pockets in sheltered places.

Manuka scrub - Established on burnt areas and encompassing a variety of sites ranging from those which manuka (*Leptospermum scoparium*) is just beginning to colonise, to dense pole stands 6-7 m high. The understorey is least developed where manuka forms dense stands, but as the canopy thins out podocarp-hardwood forest regeneration and/or dense patches of *Gahnia procera* sedge occur on drier, north-facing sites.

Yellow-silver pine scrub - Vegetation 1-3 m high, predominantly of yellow-silver pine (*Lepidothamnus intermedius*) and manuka, but including a fair proportion of leatherwood (*Olearia colensoi*), rata, rimu, kamahi, mountain flax (*Phormium cookianum*) and *Gahnia*. On more sheltered sites, occasional emergents of rimu or rata up to 8 m high are present. The canopy is mainly open to partly-closed, though dense thickets occur locally. This scrub is found most often on elevated exposed ground, such as small tablelands and broad, gently sloping ridge crests below 300 m asl.

Swampy flats - Typically clad in low vegetation and scattered shrubs. The major ground cover comprises carpets of wire rush (*Empodisma minus*) and umbrella fern [*Gleichenia dicarpa*] though where there are few other plants, mosses and lichen become more prevalent. Bare peat occurs intermittently, usually marking the location of ephemeral ponds and seepages. Flax is found mainly alongside water but some plants are scattered on higher ground. The sedge *Carex appressa* is distributed locally adjacent to water courses and in some places completely covers shallow drains. Although manuka occurs in scattered stands over lower-lying ground, it becomes more prevalent as drainage improves.

Subalpine scrub - Three to five metres high decreasing to 1 m high at the altitudinal limit of the scrub's range. Typically, this vegetation type has a tight, wind-shorn canopy of leatherwood (dominant species), rata, (*Dracophyllum longifolium*), yellow-silver pine, Hall's totara (*Podocarpus cunninghamii*) and manuka.

Alpine tops - Fell-field with wind-sculptured shrubbery amongst the shelter of rocks; ground springy underfoot, often waterlogged except around rock or if the ground slopes appreciably. The turf comprises mosses, clubmoss (*Lycopodium ramulosum*), comb sedge (*Oreobolus strictus*), tussocks (*Chionochloa* spp.), mountain daisy (*Celmisia polyvena*), *Brachyglottis bellidioides* and other herbs.

PERSONNEL

Three people with previous experience of searching for kakapo sign on Stewart Island carried out the search: Rhys Buckingham, Richard de and Peter Hanford. In addition, Craig Hodsell, a Wildlife Service trainee, assisted from 21 January.

RESULTS

A. Kakapo survey

Figure 1 is a map of southern Stewart Island showing some of the place names used in the text, the boundaries of the central kakapo study area and the boundaries of the known kakapo distribution. Figures 2 and 3 show the location and extent of searches for each of the fortnightly search periods.

1. Lee's Knob, 6-20 December 1984

Figure 4 shows the routes taken and the location of kakapo sign found. Faeces were found at 12 sites and feeding sign at 32 sites. Most sign was greater than a month old and probably resulted from feeding in the 1984 winter. However, one dropping and some moss grubbing within 100 m of each other were only about a week old. At grid reference a probable track-and-bowl system was found that had been grubbed many months previously. A male called Jimmy (0-25625), radio-tagged from March 1983 till September 1985, was caught twice about a kilometre north-east of Lee's Knob. He may have been responsible for at least some of the sign.

2. Basin Creek, 7-22 January 1985

At four sites west of Bens Bay kakapo faeces were found (Figure 5). Twenty-six faeces were present at one site, the freshest being about three weeks old.

Three occupied track-and-bowl systems were found; two at site 1 NNW of spot height '180 m', and one at site 2 (Figure 5). On the night of 12/13 January two kakapo were heard booming, one at each of the two sites. Of the two systems at site 1, a sparsely scrub-covered saddle, one was a newly-grubbed, but roughly-made, bowl by a *Gahnia procera* tussock, the other 40 m to the north being a well-established system by a manuka bush. A radio-tagged male called Bonus (R-31915) was booming from the newly-established system. The system at site 2 under tall scrub on a ridge seemed to be recent also. An unknown bird was booming from it. However, on the nights of 16/17 and 21/22 January, Bonus did not seem to be booming from site 1, and the unknown bird seemed to be booming from the well-established system at site 1. Bonus winters 3 km to the north of site 1 about spot height 376 m (Figure 6). Therefore, the sign found west of Bens Bay (Figure 5) may indicate the wintering location of the unknown male.

3. Deceit Peaks, 22 January-5 February 1985.

Although extensive searching was carried out, with most hill-tops and ridges traversed between Deceit Peaks and Three Legged Woodhen Bay (Figure 6), few kakapo sign were found. Three faeces were encountered, all greater than a month old. Probably of similar age was a grubbed area of clubmoss.

Two track-and-bowl systems were found. One at spot height 376 m consisted of two bowls and a connecting track on a sparsely vegetated hill-top (Figure 6). There was no evidence of recent activity at the system; probably it was last used during the 1983-1984 booming season. The other system, comprising two bowls and short tracks, was nearly 500 m to the south of spot height 376 m (Figure 6). It was found after a bird was heard booming on 27 January. The system looked as though it had been formed in the preceding few days. The bird booming from it was Bonus, who on the night of 12/13 January was booming in the vicinity of Basin Creek (Figure 5).

Two male kakapo are known to spend much of the non-booming season (May-November) in the vicinity of spot heights 310 m and 376 m (Figure 6). One of the birds is Bonus, the other being Lee (R-31912). Although these two birds live for much of the year about Deceit Peaks, little sign was found there. In our experience, however, feeding sign and faeces can be very difficult to find, even when a bird is known to be resident in an area, except when kakapo are grubbing for roots, rhizomes and bulbs of various plants, generally in winter.

4. Cooks Arm, 5-19 February 1985

Although extensive searching was carried out no kakapo sign was found (Figure 7). Likewise, several periods at night were spent listening from four sites, but no kakapo calls were heard. However, it was windy on these nights and so it is not conclusive that kakapo do not inhabit the region.

5. Seal Creek, 19 February-5 March 1985

While there were few kakapo feeding signs and faeces found in the Seal Creek search area, five occupied track-and-bowl systems were found. Because the fresh feeding sign and faeces were all closely associated with the occupied systems their locations are not indicated on Figure 8.

Sign at track-and-bowl system 1 (Figure 8) indicated that a kakapo had visited it briefly about two weeks prior to 26 February. Systems 2 and 3, 45 m apart on a sparsely vegetated hill, were well grubbed. Although no nights were spent listening close to these systems, the search team considered it possible that there was a bird at each of the systems.

In the vicinity of trig H and spot height 175 m several unoccupied track-and-bowl systems were located, and only one occupied system (Figure 8). Just west of trig H were seven unoccupied systems. They were situated under dense manuka-*Lepidothamnus* scrub on a ridge top. On a nearby plateau was one occupied system with a deeply-grubbed bowl (system 4), surrounded by six unoccupied systems. Only 25-30m separated neighbouring systems in this group. The vegetation over the plateau was semi-open low manuka-*Lepidothamnus* scrub. All were distinct, looking as though they had been used in the last decade. Similarly, between trig H, Seal Creek Bay and spot height 175 m 13 unoccupied systems were evident.

Track-and-bowl systems 5 and 6 (Figure 8) were on ridges under 4-8 m forest composed predominantly of rata, podocarps and inaka. System 5 had one bowl, while system 6 had three. On the night of 3/4 March, from a nearby listening site, two birds were heard calling very close to each other.

Both were considered either to be at system 6 or that one was slightly to the side of the system. Similarly, R. Russ saw two kakapo using a system near number 6 in 1977 (Russ and Anderson 1977). Three unoccupied systems were found near systems 5 and 6.

In total, 30 unoccupied systems, one recently visited system and five occupied systems were found in the Seal Creek search area. The team considered that at least four and possibly up to six male kakapo were using the occupied systems.

6. Kopeka River, 5-19 March 1985

Kakapo feeding sign was found at four sites (Figure 9). At feeding site 1 numerous grubbed patches of and 2 kakapo faeces were found over an area of 500 m. All sign was estimated to be two months of age or older. Clubmoss grubbing older than a month was found at site 2. Kakapo faeces and grubbing in moss, all older than a fortnight, were present at site 3. Lastly, at site 4 several areas of clubmoss grubbing were present, the most recent being about a week old. Jimmy (0-25625), a radio-tagged male, was located about 200 m to the SSE of this feeding site on 12 March. He was probably responsible for the most recent sign at site 4.

The team did not listen near feeding site 4 for booming from Jimmy, and he was not heard from a listening camp near trig L. However, on two other occasions booming was heard. From the listening site north-west of feeding site 2, distant booming was heard on 8 March coming from the general direction of Lees Knob (Figure 9). Much kakapo sign was found about Lees Knob (Figure 4) in December 1984. Since some males do not start booming until

January in some summers, an unknown male living in the vicinity of Lees Knob presumably began booming after the December search at an unknown track-and-bowl system.

Sporadic booms were heard on 15 March coming from a northerly direction of trig N. Since occupied track-and-bowl systems were found NNE of trig N in the next search area (Figure 10), presumably it was birds at these systems that were heard.

7. Kirklands hill, 19 March-4 April 1985

Two areas of feeding sign were found (Figure 10), both of grubbed clubmoss. They were thought to have resulted from kakapo feeding in the 1984 winter. One disused track-and-bowl system was located. It was situated on a high point of a prominent ridge (Figure 10). In addition, three occupied systems were found.

System 1 consisted of two well-grubbed bowls at a very exposed location. The north-facing bowl was beside a large rock. A bird was heard booming from this system. System 2 consisted of two bowls and extensive, well-grubbed tracks. Although no kakapo was heard booming from it, this system and the adjoining area showed signs of regular use over the past two months. It is likely that the male left the system a week or so before the team arrived in the area because it was close to the end of the booming season. The third system, a well-established one, was sited on trig 0 and a bird was heard booming from it. A large latrine was located about seven metres from the system under low manuka. It was composed of old and very recent kakapo faeces.

8. Mt Rakeahua, January 1985

In late January 1985, Mr R. Thomas and Mr I. Daniel, Department of Lands and Survey, camped on Mount Rakeahua (167° 51'E, 46° 58's). Heavy rain and high winds made listening for booming difficult; however two birds were heard booming. No track-and-bowl systems were located, but an intensive search was not made for them. Therefore, at least two males were present on the mountain then.

9. Central study area, December 1984-March 1985

This area is bounded to the west by Pegasus Creek and the Tin Range, to the north by a line through trig I and spot height 350 m, to the east by a line from spot height 350 m to the mouth of the Robertson River, and to the south by the coastline (Figure 1). Within this area, 11 males occupied track-and-bowl systems for all or part of the booming season (December 1984-March 1985). Much of the study area has been extensively searched for kakapo and track-and-bowl systems since 1977. Therefore, it is unlikely that any other males have systems within it.

10. Summary

In total, 22 occupied track-and-bowl systems (well-grubbed systems indicating use for several nights) were found during the booming season. In addition, three males were heard booming, but their track-and-bowl systems were not located (Table 1). Although there have been exceptions, a male generally occupies the same track-and-bowl system throughout a booming season and probably for life. Therefore, the total of adult males evident during the booming season was 25.

Unless other evidence is found indicating that more males are present, decisions regarding the management of the Stewart Island kakapo population should assume that there are only 25 adult males.

Table 1. Number of occupied track-and-bowl systems found and male kakapo heard during December 1984-March 1985 in southern Stewart Island.

Search Area	Number of occupied track-and-bowl systems	Estimated number of males heard
Lees Knob	-	1
Basin Creek	3	2
Deceit Peaks	1*	1*
Cooks Arm	-	-
Seal Creek	5	5
Kopeka River	-	1
Kirklands Hill	3	3
Mt Rakeahua	-	2
Central study area	11	11
TOTAL	21	25

* Not included in total as occupied by a male that was previously occupying a Basin Creek system.

11. Discussion

(a) Kakapo population size on Stewart Island in 1985

In order to make the best decisions for the conservation of the species it is important to know how many kakapo are present. Adult males are reasonably evident in breeding years because they all occupy track-and-bowl

systems for about three months and so can be counted by the characteristic sign evident at occupied systems. However, it is impossible to survey for adult females and immature birds by looking for sign because the home ranges of neighbouring birds can overlap considerably; sign cannot be ascribed to a particular bird.

In 1982 extensive searches for kakapo were made outside the booming season using muzzled dogs. Eighteen birds, seven females and 11 males, were found and transferred to Little Barrier Island. If it is assumed that the sex of the bird had no influence on whether it was found by a dog or not, an extrapolation can be made for the number of females present in 1984-85. From a ratio of seven females to 11 males, the presence of 25 adult males suggests that 16 adult females were present in 1984-1985. At that time we knew of only four females, all in the central study area.

Of the 18 birds found in 1982, plumage characteristics indicated that at least two (11%) were immature. Using this proportion of immatures to adults and the estimate of 41 adult birds, the number of immatures would be four, giving a total population of 45 kakapo on Stewart Island in 1984-1985. None of the radio-tagged birds have died since 1985 and so the estimate should be relevant in 1987.

Since 1980-1981, when kakapo numbers were estimated at the population has, at least, halved. Many of the losses can be attributed to cat predation in 1980-1982. In addition, during the same period 22 birds were transferred from the island to Maud Island and Little Barrier Island.

(b) Distribution of kakapo on Stewart Island

As a result of the 1984-1985 survey, the known range of the kakapo on Stewart Island has been increased slightly. The southern boundary is now a line extending west from Cooks Arm, just north of Hielanman, to the west coast (Figure 1). Several searches south of this line, particularly about Smiths Lookout, have failed to find any evidence of kakapo. To the west the boundary now extends up the coastline and then from Three Legged Bay to Doughboy Bay. The extent to which kakapo occur north of Deceit Peaks is unknown since no teams have thoroughly searched the catchment of Doughboy Creek. However, until such a search is carried out, the northern boundary of kakapo west of the Tin Range should be assumed to extend from Doughboy Bay to Mt Allen. On the eastern side of the Tin Range, the northern boundary now extends slightly north of Trig 0. This boundary probably extends north-east from Mt Allen, through Kirklands Hill to the Toitoi River, and then along the river to the coast. It is quite possible that one or two of the males found booming just south of Kirklands Hill spend the non-booming season to the north of the hill, slightly beyond the position of the boundary.

That kakapo have been heard booming near the summit of Mt Rakeahua in 1981 and 1985 suggests that a thorough search of the area should be made for kakapo. I assume, from the lack of reports of kakapo sign from about the mountain, that there are only a few birds living on the flanks of it. A search for these birds should be made as soon as possible because they seem to be isolated from those to the south and there has been no cat control about Mt Rakeahua.

(c) Kakapo transfer to Codfish Island

Codfish Island is situated three kilometres off the north-west coast of Stewart Island. Eradication of wekas and possums (*Trichosurus vulpecula*) from Codfish Island was considered to have been completed in May 1987. Part of the for the eradication campaign was for the transfer of some Stewart Island kakapo away from cat predation. An intense effort should be made to locate kakapo beyond the central study area, because only within the study area are efforts being made to keep cat low.

B Bird Species Survey

Figures 11 and 12 show the position and the number of each of the 1000-m grid squares visited during the kakapo search. The portions of southern Stewart Island shown in Figures 11 and 12 are the same as in Figures 2 and 3 respectively. Table 2 shows which species of forests and alpine-tops were found in each square. A few visits were made to coastal habitats. Therefore, the survey results do not give an accurate indication of the abundance or distribution of species that occupy coastal habitats. For this reason, the results for seabirds and some wetland species are provided in Table 3.

1. Stewart Island Brown Kiwi (*Apteryx australis lawryi*)

As is known for northern Stewart Island (Bull et al. 1985), the kiwi was found to be widespread in southern Stewart Island. Its presence (sightings and sign) was noted in 86% of the 222 squares visited, making it the second-most widely distributed species during the survey. Kiwi were often seen, and their presence was indicated by

sign (faeces or probe holes) in 37% of the squares. Kiwi and their sign were encountered mainly in yellow-silver pine scrub (37% of 239 occasions) and podocarp-hardwood forest (26%), but were also present in alpine tops (14%), subalpine scrub (11%), swampy flats (7%) and manuka scrub (5%).

2. Australasian Harrier (*Circus approximans*)

The harrier was seen in 10 squares (5%). These squares were situated at four widely separated locations; about open flats midway between Three Legged Bay and Deceit Peaks, about open flats west of Cooks Arm, and over scrubland near Smiths Lookout and near trig P. Since the birds are capable of travelling long distances in a day and were infrequently seen, it is likely that they do not remain long in one region of southern Stewart Island before venturing elsewhere to forage.

3. New Zealand dotterel (*Charadrius obscurus*)

New Zealand dotterel were seen only west and south of the Tin Range. They were present in five squares at three widely separated sites; near Deceit Peaks (squares 19 & 35), near Fraser Peaks (squares 79 & 87) and near Smiths Lookout (square 113). All birds were in alpine habitats (220-470 m asl) containing wind-stunted vegetation, open areas covered by bare rock and mat plants, and seepages, streams or tarns. The sighting in square 113 was of a bird incubating three eggs on 15 February 1985. The nest was a slight depression in the ground next to a *Gahnia procera* plant. Little is known about the present status and breeding biology of the New Zealand dotterel population of Stewart Island.

4. New Zealand Pigeon (*Hemiphaga novaeseelandiae*)

Pigeons were observed in 47 squares (21%) and on only three occasions were they in flight. Of 41 occasions in which notes were made of the vegetation type the pigeons were in, 85% were of podocarp-hardwood forest. On the other occasions, the pigeons were in yellow-silver pine scrub. The predominance of sightings in podocarp-hardwood forest is to be expected considering that the pigeon's main foods are the leaves and fruits of podocarps and hardwoods (Falla et al. 1979, O'Donnell & Dilks 1986). The few sightings of pigeons west of Deceit Peaks, west and south of Basin Creek, and between Lees Knob, trig P, trig N and trig M seems to reflect the lack of podocarp-hardwood forest in these areas. Pigeons can move long distances to exploit seasonally available foods (M. Clout pers. comm.), and so they may use the other vegetation types in the survey area to a greater degree outside of summer.

5. South Island Kaka (*Nestor meridionalis*)

Kaka were encountered in 15 squares (7%). This is a sparse distribution compared with kakas in 42% of 1789 squares in 15 South forests Westland forests (O'Donnell & Dilks 1986) and in 71% of 227 squares in Waitutu Forest (Elliott & Ogle 1985). It is, however, in agreement with the finding of O'Donnell and Dilks (1986) that the species was scarce in lowland podocarp-hardwood forests of South Westland.

In the survey area, kaka were present about the lower reaches of Basin Creek and Seal Creek, and near Trig. Although kakas were scarce in the lowland podocarp-hardwood forests of South Westland, they were found on 67% of 15 occasions in podocarp-hardwood forest and 6% of occasions in yellow-silver pine scrub in southern Stewart Island. On the rest of the occasions the birds were in

these vegetation types, but it was not specified which. The kaka feeds on fruit, nectar and invertebrates (Falla et al. 1979) and the most important tree species to them in South Westland were silver beech (*Nothofagus menziesii*) (which is not present on Stewart Island), kamahi, rata and rimu (O'Donnell & Dilks 1986). Thus, it is understandable why most kaka encounters in southern Stewart Island were in podocarp-hardwood forest and yellow-silver pine scrub.

Old kaka sign, as horizontal grooves on the tree trunks, was frequently seen in coastal podocarp forest between the Kopeka River and Robertson River. These grooves are made by kaka to feed on the sap that oozes from such cuts. The incidence of this old sign suggests that there were more kaka previously in the region than in 1985.

6. Parakeet spp. (*Cyanoramphus* spp.).

Parakeets were seen in 45% of the 222 squares. In general, they were encountered infrequently in manuka scrub, subalpine scrub and swampy flats, being present mainly in podocarp-hardwood forest (71% of 136 occasions) and yellow-silver pine scrub (25%). While both red-crowned parakeets (*C. novaezealandiae*) and yellow-crowned parakeets (*C. auriceps*) eat a variety of foods, such as seeds, berries, fruits, buds, flowers, shoots and invertebrates, much of the diet consists of seeds, berries and fruits when these foods are available (Taylor 1985). Probably the availability of unripe fruit of *Dacrydium*, *Lepidothamnus* and *Podocarpus* species for much of the year in the survey area resulted in the parakeets being recorded mainly in podocarp-hardwood forest and yellow-silver pine scrub. Because of this apparent habitat preference of the parakeet and the distribution of the favoured vegetation types in the search area, parakeets were present mainly in the Basin Creek and Seal Creek catchments, and about trig 0 and Kirklands Hill.

Often it was not possible to determine the species of parakeet present, either because they were in flight or were out of sight in the tops of tall trees. Of the 100 squares in which parakeets were encountered, red-crowned parakeets were identified in 31% of them. Yellow-crowned parakeets were not seen during the survey, but were reported by observers in 1969-1979 from several sites in northern Stewart Island (Bull et al. 1985). This is in contrast to the results for Waitutu Forest (Elliott & Ogle 1985) and South Westland forests (O'Donnell & Dilks 1986), where only yellow-crowned parakeets were identified.

7. Long-tailed Cuckoo (*Eudynamis taitensis*)

A long-tailed cuckoo was heard calling in flight on 13 January 1985 at 0200 h over square 57. This cuckoo has a sparse distribution on the island (Bull et al. 1985), with its host species there being the brown creeper (*Finschia novaeseelandiae*) (Falla et al. 1979).

8. Morepork (*Ninox novaeseelandiae*)

Moreporks were encountered in 9% of the squares. This seems a low result considering their wide distribution reported by Bull et al. (1985). Since the survey team were present in a limited number of squares by night and few seen by day, the distribution in southern Stewart Island is likely to be more extensive than these results suggest.

9. New Zealand Kingfisher (*Halcyon sancta*)

Kingfishers were recorded in nine squares; three coastal squares near Bens Bay (69, 77 & 83), two coastal squares

along Cooks Arm, (93 & 94) and four inland squares near trig 0 (143, 152, 166 & 178). The species has a widespread coastal distribution about Stewart Island (Bull et al. 1985).

10. Skylark (*Alauda arvensis*)

This species was recorded twice about Lees Knob (squares 170 & 180). It is known to be widely dispersed in northern Stewart Island (Bull et al. 1985).

11. New Zealand Pipit (*Anthus novaeseelandiae novaeseelandiae*)

The pipit was found in 35 (16%) of the squares. Its distribution reflects its apparent preference for open habitats, birds being found in alpine tops west of Deceit Peaks, from Gog to Smiths Lookout and from Lees Knob to Kirklands Hill. In addition, pipits inhabited lowland swampy flats northeast of Hielanman. The species is widely distributed in Stewart Island (Bull et al. 1985).

12. Hedgesparrow (*Prunella modularis*)

Hedgesparrows were encountered at scattered locations throughout the survey area, being present in 28% of squares. By comparison, they were present in 13% of squares in Waitutu Forest (Elliott & Ogle 1985) and 6% of squares in 15 South Westland forests (O'Donnell & Dilks 1986). On Stewart Island the species is secretive, being seen mainly in the breeding season when they sing from tree-tops. Since the survey was carried out towards the end of the breeding season and during the moult, it is likely that birds in some squares went undetected. Outside the breeding season, hedgesparrows give brief alarm calls when disturbed, but otherwise they remain quiet. In keeping with their behaviour, hedgesparrows were heard on 76% of the 45 occasions they were encountered.

Hedgesparrows were not found in coastal scrub. Their percentage occurrence in the other vegetation types was: yellow-silver pine 44%, alpine tops 18%, podocarp-hardwood forest 16%, subalpine scrub 10%, manuka scrub 9% and swampy flats 3%.

13. Stewart Island Fernbird (*Bowdleria punctata stewartiana*)

Fernbirds were found in 35 (16%) of the squares. They were present in two areas, southwest of Deceit Peaks (5 squares) and over a wide area between Lees Knob, trig M and Hill (28 squares). In addition, a was seen near Hielanman (square 85) and another was heard near Smiths Lookout (square 116). Elsewhere in Stewart Island the species is restricted to several parts of the Freshwater-Mason Bay flats and at Doughboy Bay (O'Donnell 1984).

Fernbirds were encountered on a similar proportion of occasions (n=40) in four vegetation types; yellow-silver pine scrub (23%), swampy flats (30%), subalpine scrub (20%) and alpine tops (27%). This result is consistent with the findings of Best (1979) that South Island fernbirds (*B. p. punctata*) preferred habitats of low, dense ground vegetation with emergent shrubbery. At the Freshwater flats the fernbirds inhabited manuka less than a metre high over swampy flats and at Doughboy Bay they were in taller manuka at the beach edge (O'Donnell 1984).

14. Brown Creeper (*Finschia novaeseelandiae*)

Brown creepers were widely distributed through the survey area, being found in 31% of squares. Similarly, the results presented by Bull et al. (1985) show that the brown creeper was widely distributed in northern Stewart Island too.

The species was present in all vegetation types, except coastal scrub, but was encountered mainly in yellow-silver pine scrub (54% of 69 occasions). By comparison, brown creepers in Waitutu Forest preferred podocarp stands that contained up to 50% silver beech (Elliott & Ogle 1985). Similarly, those in South were seen mainly in forests containing silver beech, rimu and kamahi (O'Donnell & Dilks 1986). Since yellow-silver pine scrub on Stewart Island contains a high proportion of podocarp and hardwood species, particularly rimu and kamahi, the suite of plant species in which foraging brown creepers spend much time, is probably much the same as that used by brown creepers in Waitutu Forest and South forests.

15. Grey Warbler (*Gerygone igata*)

The grey warbler was widely distributed in southern Stewart Island, being present in 52% of visited squares. Likewise, Bull et al. 1985 showed that the species was present in all but one of the Stewart Island 10,000-yard grid squares.

The grey warbler was present in all vegetation types, except coastal scrub, in which little time was spent searching. It was found most often in podocarp-hardwood forest (52% of 145 occasions). The percentage occurrence of the species in the other vegetation types was: yellow-silver pine scrub 28%, subalpine scrub 8%, swampy flats 5%, alpine tops 4% and manuka scrub 3%. By comparison, the data for the grey warbler in Waitutu Forest showed that it had no clear forest-type preference (Elliott & Ogle 1985). In South Westland the warbler was seen in a wide range of plant species, using kamahi, silver beech and rimu most frequently (O'Donnell & Dilks 1986).

16. South Island Fantail (*Rhipidura fuliginosa fuliginosa*)

The fantail was infrequently encountered; being present in only 25 squares (11%). It had a patchy distribution, being found near Three Legged Bay, in the Basin Creek and Seal Creek catchments, and near Kirklands Hill. In southern Stewart Island the species seems to inhabit few vegetation types, being found in only podocarp-hardwood forest (94% of 33 occasions) and yellow-silver pine scrub. The fantails in Waitutu Forest seem to inhabit similar vegetation types as those in southern Stewart Island; a tall, complex forest having a high component of podocarp and hardwood trees (Elliott & Ogle 1985). By comparison, in South the fantail used the various plant species and tree sizes fairly evenly, implying it did not prefer a particular vegetation type (O'Donnell & Dilks 1986).

17. Yellow-breasted Tit (*Petroica macrocephala macrocephala*)

The tit was widely distributed through the survey area, being found in 77% of the squares. Likewise, the results presented by Bull et al. (1985) showed the species is widespread in Stewart Island. Tits were found in all vegetation types, but particularly in yellow-silver pine scrub (42% of 271 occasions) and podocarp-hardwood forest (38%). The percentage occurrence of the species in the other vegetation types was: subalpine scrub 8%, swampy flats 7%, alpine tops 3%, manuka scrub 2% and coastal scrub <1%. Yellow-breasted tits in Waitutu Forest and South forests showed no preference for any broad forest categories (Elliott & Ogle 1985, O'Donnell & Dilks 1986).

18. Stewart Island Robin (*Petroica australis rakiura*)

The robin had a disjunct distribution in the survey area, being present in four squares southwest of Deceit Peaks and in 18 squares between trig L and Kirklands Hill. In

addition, robins were present about Scollays Flat. The species was largely confined to swampy flats (49% of 31 occasions) and yellow-silver pine scrub (42%). Similarly, O'Donnell (1984) found that the robin had a patchy distribution over the Freshwater flats, being common in manuka-dominated (3-5m high) shrublands. By comparison, Elliott & Ogle (1985) found that the South Island robin (*P. a. australis*) in Waitutu Forest was largely restricted to valley floor sites of beech-dominated or mixed beech-podocarp forest. They did not find the robin in yellow-silver pine scrub or unlogged podocarp-dominated forest. The equivalent vegetation type on Stewart Island would be the podocarp-hardwood forest, in which no robins were encountered.

19. Song Thrush

This introduced species was noted in only three squares (68, 93 & 179). Similarly, the results presented by Bull et al. (1985) indicated the song thrush had a sparse distribution in Stewart Island, particularly in the southern portion. In Waitutu Forest and South Westland forests song thrushes were uncommon also (Elliott & Ogle 1985, O'Donnell & Dilks 1986). O'Donnell and Dilks noted that while thrushes in South Westland were encountered in all forest types, most often they were in disturbed sites, scrub margins and forest edges. This finding may explain why there were few song thrushes in southern Stewart Island; the forests there were relatively undisturbed by people.

20. Blackbird

In contrast to the song thrush, the blackbird was widely distributed and fairly common in southern Stewart Island, being present in 26% of the squares. Blackbirds in South Westland forests were, apparently, more widely distributed, than in southern Stewart Island, being found

in over 80% of squares (O'Donnell & Dilks 1986). Blackbirds in forest tend to be secretive, particularly outside the breeding season (February-August) when they mainly give brief alarm calls. This is in contrast to the long periods of song males give from exposed perches in the breeding season. This may account for the few records of blackbirds in the Seal Creek, Kopeka River and Kirklands Hill search areas, which were surveyed from mid-February onwards.

Blackbirds were found in all vegetation types, particularly podocarp-hardwood (31% of 54 occasions), yellow-silver pine scrub (28%) and subalpine scrub (20%). Similarly, blackbirds were found in all forest types in South Westland (O'Donnell & Dilks 1986), but in Waitutu Forest the species was found to prefer beech-dominated forest types over podocarp-dominated forest types (Elliott & Ogle 1985).

21. Silvereye (*Zosterops lateralis*)

Although widespread, the silvereye was patchily distributed and present in 21% of squares. By comparison, the species was recorded in 67% of squares visited in Waitutu Forest, with the population being described as common but not especially abundant (Elliott & Ogle 1985). Since silvereyes take much fruit and nectar when they are available (Falla et al. 1979), the species' low abundance in southern Stewart Island may reflect that these foods are rarely abundant there, and if so, it is only for a brief period. While present in all vegetation types, silvereyes were recorded most frequently in podocarp-hardwood forest (49% of 49 occasions) and yellow-silver pine scrub (29%). These two vegetation types contain a greater diversity of plant species that produce nectar and fruit than do the other vegetation types.

22. Bellbird (*Anthornis melanura*)

The bellbird was the most widespread and, probably, the most abundant bird encountered during the survey, being found in 95% of the 222 squares visited. Similarly, it was found to be widespread in Waitutu Forest (present in 85% of squares) (Elliott & Ogle 1985) in South Westland forests (about 95%) (O'Donnell & Dilks 1986).

This widespread nature of the bellbird results, in part, because it has a varied foraging repertoire, it eats a variety of foods and it dominates most competing bird species at sites where food is readily available, enabling it to utilise most vegetation types. It was rarely seen in coastal scrub, with the majority of bellbirds being encountered in yellow-silver pine scrub (37% of 378 occasions), podocarp-hardwood forest (30%) and subalpine scrub (12%). Likewise, O'Donnell & Dilks (1986) found bellbirds to be common and widespread in all forest types of the 15 South forests they studied.

23. Tui (*Prothemadera novaeseelandiae*)

The tui was patchily distributed, being present in 41% of the squares. Similarly, the species was encountered in over 40% of squares in most of the forests in South Westland surveyed by O'Donnell & Dilks (1986) and in 28% of the squares in Waitutu Forest (Elliott & Ogle 1985). Tui were seen in all forest types in southern Stewart Island, except in coastal scrub. However, in comparison with the bellbird, the tui was found a greater proportion of times in podocarp-hardwood forest (57% of 127 occasions). The percentage occurrence of the tui in the other vegetation types was yellow-silver pine scrub 24%, subalpine scrub swampy flats 7%, alpine tops 2% and manuka scrub 1%. Likewise, tui were encountered in all forest types in the South Westland forests (O'Donnell & Dilks 1986).

24. Chaffinch (*Fringilla coelebs*)

The chaffinch is an uncommon bird in southern Stewart Island, where it was found in 8% of the squares. This is surprising considering it was encountered in 56% of the squares visited in Waitutu Forest (Elliott & Ogle 1985) and 43% of the squares visited in 15 South Westland forests (O'Donnell & Dilks 1986). In southern Stewart Island, chaffinches found mainly in yellow-silver pine scrub (53% of 15 occasions) and podocarp-hardwood forest (33%). Likewise, in Waitutu Forest, chaffinches preferred forest types where most of the canopy trees were podocarp and beech species (Elliott & Ogle 1985).

25. Greenfinch (*Carduelis chloris*)

This finch was encountered on only four occasions (squares 68, 93, 180 & 192) in southern Stewart Island. The survey results presented by Bull et al. 1985 also show the greenfinch to be uncommon throughout Stewart Island. Likewise, the species was rare in Waitutu Forest (Elliott & Ogle 1985) and in South Westland forests (O'Donnell & Dilks 1986).

26. Redpoll (*Acanthis flammea*)

The redpoll was the fourth most widely distributed species, being found in 69% of the squares. In Waitutu Forest, it was found in 62% of squares, but in the South forests it was present in only 37% of squares.

This finch was found in all vegetation types in southern Stewart Island, particularly yellow-silver pine scrub (36% of 198 occasions) and alpine tops (25%). The redpoll was the passerine most frequently seen in alpine tops, probably because of the abundance of seed-producing *Chionochoa* species and herbs. Seeds are an important part of the diet of redpolls. Likewise, the high

percentage occurrence of the redpoll in yellow-silver pine scrub presumably resulted because of the variety of seed-producing plants in it, for example, *Lepidothamnus* species, manuka and *Gahnia procera*. O'Donnell & Dilks (1986) found that the highest frequency of occurrence of the redpoll was in areas dominated by mixed podocarp forest. In Waitutu Forest redpolls seemed to prefer high altitude forest types in close proximity to open country, such as clearings, alpine scrub and tussock lands (Elliott & Ogle 1985).

DISCUSSION

There is little published information about the status of birds on Stewart Island, particularly those species inhabiting the southern portion. These survey results provide more detailed information than was available for the birds of the forest and scrub habitats of southern Stewart Island. In general, the results show that most native species are reasonably widespread in the region and that their populations seem assured in the long-term, as long as no catastrophe occurs.

Little is known about the size and status of the Stewart Island population of the New Zealand Dotterel. As well as determining these data, it would be important to know the breeding success of the population, particularly with respect to the impact of cats and rats.

From his studies at the Freshwater-Mason Bay river flats, 1977-1981, C.F.J. O'Donnell (pers. comm.) found the Stewart Island and Stewart Island robin in vegetation types that have a patchy and relatively limited distribution. He considered that the population of these river flats declined during his study. For these reasons it would be useful to have detailed information about the two species' distributions and habitat requirements.

Concerns have been expressed about the long-term survival prospects of kaka populations (O'Donnell & Dilks 1986, Williams 1986). The South Island kaka's status is given as regionally rare (Bell 1986). Observations of kaka in South Westland forests indicated that there was a large overlap between the preferred food trees of kaka and possums (O'Donnell & Dilks 1986). They also found that there were few kaka north of the Paringa River where possum numbers were high, and that kaka were abundant in silver beech forests to the south of the river, which had mixtures of rata and kamahi, a large component of mistletoes and few possums. These results suggest that an effort should be made to monitor kaka numbers at a few sites on Stewart Island over many years. With the recent eradication of possums from Codfish Island it would be important to include this site in the monitoring programme to document whether kaka numbers increase there with the recovery of the vegetation from possum browsing.

The results of this survey and that of the Ornithological Society of New Zealand (Bull et al. 1985), and the findings of O'Donnell (1984) indicate that the Stewart Island brown kiwi is widespread, inhabits all vegetation types and exists at relatively high densities in some localities compared with brown kiwi populations elsewhere. For these reasons the future of the Stewart Island brown kiwi seems secure. However, it would be of interest to know what impact, if any, wild cats (*Felis catus*) are having on the productivity of the kiwi.

Evidence is now available that the South Island kokako (*Callaeas cinerea cinerea*) is present in low numbers in the catchment of the Rakeahua River of Stewart Island (Buckingham 1987). During the survey of southern Stewart Island, Rhys Buckingham heard calls on three occasions which were similar to those of kokako and so a few kokako may be in the region.

However, I consider that until a stimulus is found that will readily attract kokako into view or sign identified that can be attributed to kokako alone, nothing can be done to determine the distribution and status of the species on Stewart Island.

Two species present on Stewart Island, the South Island rifleman (*Acanthisitta c. chloris*) and the Stewart Island weka (*Gallirallus australis scotti*), were not seen or heard during the survey. The rifleman is widely distributed over northern Stewart Island (Bull et al. 1985). What factors prevent it from colonising the southern portion of the island is unknown.

At present the weka occurs about Halfmoon Bay and on some of Stewart Island's offshore islands (Bull et al. 1985). Although many field-parties searched much of southern Stewart Island for kakapo between 1977 and 1985, none reported having seen or heard weka. Between November 1979 and April 1981 about 900 wekas were transferred from Codfish Island to Stewart Island. They were liberated mainly at Waituna Bay, West Ruggedy Beach, East Ruggedy Beach and Halfmoon Bay. Although these birds were seen about the release sites for several months, they gradually disappeared. By 1987 weka numbers on Stewart Island had declined to pre-1979 levels, with a few birds about Halfmoon Bay and on the islets nearby (R. Tindale pers. comm.)

C. Lizard Species Survey

1. Harlequin Gecko (*Hoplodactylus rakiurae*)

Three specimens of this distinctively marked gecko were at widely separated sites. On the 15 December 1984, one was found near Lees Knob (NZMS 260, sheet C49, D49 at 166/330) on moss under a two-metre high manuka tree. The

second gecko was caught on 9 January 1985 near the headwaters of basin Creek (019/257) among pig fern (*Paesia scaberula*). The third gecko was found on 15 March 1985 near the headwaters of the Kopeka River (193/336). This animal was seen on an upper branch of a 45 cm high stunted manuka tree. In addition, several other harlequin geckos were found by Wildlife Service personnel in 1984-1987 about Scollay's Flat, on the Tin Range and near Deceit Peaks. All the positions of these captures occur within the known distribution of the species (Thomas 1981).

2. Green Skink

In early December 1984, five skinks were tentatively identified as being of this species. They were observed at two locations near Lees Knob (1365/3275 & 1465/3125). Two of the skinks were seen on leaf litter under low scrub, and the other three were on bare rocks near crevices. This skink is known previously from Stewart Island (Towns 1985).

3. Common Skink (*Leiopisma nigriplantare maccanni*)

Nine skinks of this species were caught and identified. These specimens were from Basin Creek in the south to Kirklands Hill in the northeast. However, the search team stated that on many occasions skinks were seen, but eluded capture. From the size and colour pattern of these skinks, the team was sure they were common skinks and that the species was distributed throughout the search area. This skink was seen in fairly open country, such as subalpine scrub and alpine tops, either on ground-plants or on the branches and foliage of stunted trees.

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REFERENCES

- BELL, B.D. 1986. The conservation status of New Zealand wildlife. Occasional Publication No. 12. New Zealand Wildlife Service, Wellington.
- BEST, H.A. 1979. Observations on habitat selection by South Island fernbirds (*Bowdleria punctata punctata*). Notornis 26: 279-287.
- BEST, H.A. 1982. An appraisal of kakapo research and management. Unpublished report. New Zealand Wildlife Service file 30/3/17, Wellington.
- BEST, H.A. 1984. The foods of kakapo on Stewart Island as determined from their feeding sign. New Zealand Journal of Ecology 7: 71-83.
- BUCKINGHAM, R. 1987. Kokako presence on Stewart Island. Notornis 34: 167.
- BULL, P.C.; P.D. GAZE & C.J.R. ROBERTSON 1985. The atlas of bird distribution in New Zealand. The Ornithological Society of New Zealand Inc, Wellington.
- ELLIOTT, G.P. & C.C. OGLE 1985. Wildlife and wildlife habitat values of Waitutu Forest, Western Southland. Fauna Survey Unit report no 39. New Zealand Wildlife Service, Wellington.
- FALLA, R.A.; R.B. SIBSON & E.G. TURBOTT 1979. The new guide to the birds of New Zealand and outlying islands. Collins, Auckland

- MERTON, D.V. 1982. The kakapo: a recovery plan. Unpublished report. New Zealand Wildlife Service, Wellington.
- O'DONNELL, C.F.J. 1984. Wildlife values of the Mason Bay flats, Stewart Island. New Zealand Wildlife Service file 31/6/3.
- O'DONNELL, C.F.J. & P.J. DILKS 1986. Forest birds in South Westland; status, distribution and habitat use. Occasional Publication no 10. New Zealand Wildlife Service, Wellington.
- RUSS, R. & J. Anderson 1977. The Robertson River and Seal Creek results of the Jan/Feb 1977 kakapo search, Stewart Island. New Zealand Wildlife Service file 25/3/4.
- TAYLOR, R.H. 1985. Status, habits and conservation of *Cyanoramphus* parakeets in the New Zealand region. ICBP technical publication 3: 195-211.
- THOMAS, B.W. 1981. *Hoplodactylus rakiurae* n.sp. (Reptilia: Gekkonidae) from Stewart Island, New Zealand, and comments on the taxonomic status of *Heterophilis nebulosus* McCann. New Zealand Journal of Zoology 8: 33-47.
- TOWNS, D.R. 1985. A field guide to the lizards of New Zealand. Occasional Publication no 7. New Zealand Wildlife Service, Wellington.
- WILLIAMS, M.J. 1986 Native bird management. Forest and Bird 17: 7-9.
- WILSON, H.D. 1982. Field guide to Stewart Island plants. Field Guide Publications, Christchurch.

Table 1. Number of occupied track-and-bowl systems found and male kakapo heard during December 1984 - March 1985 in southern Stewart Island.

Search area	Number of occupied systems	Estimated number of males heard
Lees Knob	-	1
Basin Creek	3	2
Deceit Peaks	1*	1*
Cooks Arm	-	-
Seal Creek	5	5
Kopeka River	-	1
Kirklands Hill	3	3
Mt Rakeahua	-	2
Central study area	11	11
Total	22	25

* Not included in total as occupied by a male that was previously occupying a Basin Creek system.

Table 2. The bird species found in each of 222 1000-m grid squares in southern Stewart Island visited by the search team.

Species	Square number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Stewart Is. kiwi	+	+	+	+	+	+	+		+	+	+	+	+	+
NZ pigeon										+				
Parakeet sp.		+			+		+			+				
NZ pipit											+			
Hedgesparrow	+	+			+						+		+	+
Brown creeper							+			+	+		+	
Grey warbler	+						+			+				
Yellow-breasted tit	+	+	+		+	+	+			+	+	+	+	
Blackbird		+	+		+	+	+			+	+			
Bellbird	+	+	+	+	+	+	+		+	+	+	+	+	+
Tui							+							
Redpoll		+	+		+			+	+	+	+	+	+	+

Species	Square number													
	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Stewart Is. kiwi	+	+	+		+	+	+	+	+	+	+	+	+	+
NZ dotterel					+									
NZ pigeon	+													
Parakeet sp.		+			+		+	+	+	+	+	+	+	
Morepork							+							
NZ pipit	+		+											+
Hedgesparrow	+	+	+	+	+		+	+						
Stewart Is. fernbird				+	+					+		+		
Brown creeper	+		+	+	+	+			+	+				
Grey warbler	+			+				+	+	+	+			
South Is. fantail		+												
Yellow-breasted tit	+	+	+	+	+	+	+	+		+	+	+	+	
Stewart Is. robin											+			
Blackbird			+											
Silvereye							+		+	+				
Bellbird	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tui							+			+				
Chaffinch											+			
Redpoll	+	+	+	+	+	+	+	+	+	+	+	+	+	

Species	Square number													
	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Stewart Is. kiwi	+		+	+	+	+	+	+	+	+	+		+	+
Australasian harrier				+	+									
NZ dotterel							+							
NZ pigeon						+								
Parakeet sp.			+		+	+		+	+	+	+	+		
NZ pipit					+									
Hedgesparrow	+							+						
Stewart Is. fernbird			+											
Brown creeper			+	+	+	+	+	+				+		

Table 2 contd

Grey warbler			+	+	+	+		+	+	+	+			+
South Is. fantail								+	+					
Yellow-breasted tit			+	+	+	+		+	+	+	+	+		+
Stewart Is. robin				+	+	+								
Blackbird			+	+		+	+	+						
Silvereye		+						+	+	+		+		
Bellbird	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tui			+	+	+			+		+	+	+		
Chaffinch					+									
Redpoll	+	+	+	+	+	+	+		+	+				+

Species	Square number													
	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Stewart Is. kiwi	+	+	+	+	+	+	+		+		+	+		+
NZ dotterel												+		
NZ pigeon				+								+		
Parakeet sp.		+	+	+				+	+		+	+	+	+
Morepork											+			
NZ pipit								+						
Hedgesparrow				+							+			+
Browncreeper						+	+		+	+				+
Grey warbler		+		+		+			+		+	+	+	+
South Is. fantail													+	+
Yellow-breasted tit		+	+	+	+	+		+	+		+	+	+	+
Blackbird											+	+		+
Silvereye									+					+
Bellbird	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tui				+					+	+	+			+
Redpoll				+		+	+	+	+	+	+	+		+

Species	Square number													
	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Stewart Is. kiwi	+	+	+	+	+	+	+	+	+	+	+	+		
NZ pigeon	+		+	+	+		+					+		
South Is. kaka	+			+					+			+		+
Parakeet sp.	+		+	+	+	+	+	+	+	+	+	+	+	+
Morepork	+				+				+					
NZ kingfisher													+	
Hedgesparrow	+	+	+		+				+					
Brown creeper	+	+			+	+	+		+					
Grey warbler	+		+	+	+	+	+		+	+	+	+	+	+
South Is. fantail	+			+	+	+	+			+	+			+
Yellow-breasted tit	+	+	+	+	+	+	+	+	+	+	+	+	+	
Song thrush												+		
Blackbird	+	+		+	+	+	+	+	+	+	+		+	
Silvereye					+	+		+	+			+		
Bellbird	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tui	+	+	+		+	+	+	+	+	+		+	+	+
Chaffinch									+	+				
Redpoll	+	+	+	+	+		+	+	+		+	+		

Table 2 contd

Species	Square number															
	71	72	73	74	75	76	77	78	79	80	81	82	83	84		
Stewart Is. kiwi	+	+	+	+	+			+		+	+	+				
Australasian harrier														+		
NZ dotterel									+							
NZ pigeon						+	+					+	+			
South Is. kaka							+					+				
Parakeet sp.		+	+	+	+	+	+			+	+	+	+			
NZ kingfisher							+						+			
NZ pipit														+		
Hedgesparrow	+	+	+		+		+			+	+	+		+		
Brown creeper											+	+		+		
Grey warbler			+		+	+	+		+		+	+		+		
South Is. fantail					+		+				+	+				
Yellow-breasted tit	+		+	+	+	+	+	+	+	+	+	+	+	+		
Blackbird			+	+		+	+		+		+	+		+		
Silvereye	+	+	+			+					+	+				
Bellbird	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Tui	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Chaffinch			+	+	+	+						+				
Greenfinch											+					
Redpoll	+	+	+	+	+	+		+	+	+	+	+		+		

Species	Square number															
	85	86	87	88	89	90	91	92	93	94	95	96	97	98		
Stewart Is. kiwi	+	+	+			+	+	+	+	+	+	+	+	+		
Australasian harrier			+													
NZ dotterel			+													
NZ pigeon									+	+						
Parakeet sp.				+						+		+				
NZ kingfisher									+	+						
NZ pipit	+	+	+					+	+							
Hedgesparrow									+							
Stewart Is. fernbird	+															
Brown creeper	+		+								+	+		+		
Grey warbler									+	+			+			
Yellow-breasted tit				+		+	+		+	+						
Song thrush									+							
Blackbird			+	+					+	+						
Silvereye			+													
Bellbird	+	+	+	+	+	+	+		+	+	+	+	+	+		
Tui			+	+					+	+	+	+				
Greenfinch	+	+			+	+										
Redpoll	+	+	+	+	+	+	+	+			+	+	+	+		

Species	Square number										
	99	100	101	102	103	104	105	106	107	108	109
Stewart Is. kiwi		+	+	+	+	+	+	+			+
Australasian harrier				+							+
NZ pigeon				+							
Parakeet sp.											+
Morepork				+							

Table 2 contd

NZ pipit	+	+	+		+	+	+	+		+	+
Hedgesparrow			+		+	+	+		+	+	
Brown creeper	+										
Grey warbler				+						+	+
Yellow-breasted tit	+			+	+			+		+	+
Blackbird											+
Silvereye										+	
Bellbird	+	+	+	+	+	+	+	+	+	+	+
Tui				+						+	
Greenfinch										+	
Redpoll	+	+	+		+	+	+	+	+	+	

Species	Square number										
	110	111	112	113	114	115	116	117	118	119	120
Stewart Is. kiwi	+	+					+		+		+
Australasian harrier											+
NZ dotterel					+						
NZ pigeon			+								
Parakeet sp.			+			+			+		
NZ pipit	+	+	+								
Hedgesparrow	+				+						
Stewart Is. fernbird							+				
Brown creeper		+									
Grey warbler									+		+
Yellow-breasted tit								+	+	+	+
Blackbird		+									
Bellbird	+	+	+			+	+	+	+	+	+
Tui											+
Redpoll		+	+				+			+	+

Species	Square number										
	121	122	123	124	125	126	127	128	129	130	131
Stewart Is. kiwi	+	+			+	+	+	+	+	+	+
Australasian harrier		+									
NZ pigeon							+	+	+		
Parakeet sp.						+	+	+	+		+
Hedgesparrow											+
Stewart Is. fernbird											+
Grey warbler	+	+	+			+	+	+	+		+
South Is. fantail							+	+	+		
Yellow-breasted tit		+			+	+	+	+	+	+	+
Blackbird		+									
Silvereye		+					+	+	+		+
Bellbird	+		+		+	+	+	+	+	+	+
Tui	+	+	+				+	+	+		
Chaffinch								+			
Redpoll	+	+	+	+	+	+				+	

Table 2 contd

Species	Square number										
	132	133	134	135	136	137	138	139	140	141	142
Stewart Is. kiwi		+	+	+	+	+	+	+	+	+	+
Australasian harrier											+
South Is. kaka				+	+						
NZ pigeon			+	+	+						
Parakeet sp.		+	+	+	+						
Morepork		+								+	+
NZ pipit						+			+		+
Hedgesparrow			+						+		+
Stewart Is. fernbird	+					+	+		+	+	+
Grey warbler		+	+	+	+					+	
South Is. fantail			+								
Yellow-breasted tit	+	+	+	+	+		+		+	+	+
Stewart Is. robin											+
Blackbird				+							
Silvereye			+	+							+
Bellbird	+	+	+	+	+		+		+	+	+
Tui			+	+	+						
Chaffinch			+						+		
Redpoll		+				+	+	+	+	+	+

Species	Square number										
	143	144	145	146	147	148	149	150	151	152	153
Stewart Is. kiwi	+	+	+	+	+	+	+	+	+	+	+
Australasian harrier										+	+
NZ pigeon	+		+								
Parakeet sp.	+		+								+
Morepork	+										+
NZ kingfisher	+									+	
NZ pipit		+						+	+		
Hedgesparrow											+
Stewart Is. fernbird	+	+			+		+	+			
Brown creeper								+	+	+	
Grey warbler	+		+			+		+	+	+	
Yellow-breasted tit	+	+	+			+	+		+	+	+
Stewart Is. robin	+	+				+			+	+	+
Blackbird	+		+				+				
Silvereye	+	+	+								
Bellbird	+	+	+	+	+	+	+	+	+	+	+
Tui			+								
Chaffinch	+										
Redpoll	+	+		+	+	+	+	+	+	+	+

Species	Square number										
	154	155	156	157	158	159	160	161	162	163	164
Stewart Is. kiwi	+	+	+	+	+			+	+	+	+
NZ pigeon	+	+									+
Parakeet sp.	+	+								+	+
NZ pipit				+							
Hedgesparrow						+					
Stewart Is. fernbird			+			+	+	+		+	

Table 2 contd

Tui	+	+	+	+	+	+	+	+	+	+	+	+
Chaffinch											+	
Redpoll	+								+			

Species	Square number		
	220	221	222
Stewart Is. kiwi	+	+	+
NZ pigeon	+	+	
South Is. kaka		+	
Parakeet sp.	+	+	+
Hedgesparrow	+		+
Brown creeper		+	
Grey warbler	+	+	+
Yellow-breasted tit	+	+	+
Silvereye		+	
Bellbird	+	+	+
Tui	+	+	+
Redpoll		+	

TABLE 3. For each seabird and some wetland species recorded during the survey of southern Stewart Island is provided the grid squares they occupied and comments. The positions of the 1000-m grid squares are shown in Figures 11 and 12.

Species	Squares in which species were recorded	Comments
Little blue penguin	218	Widespread about Stewart Island coastline (Bull et al. 1985).
Fiordland-crested penguin	218	Breeds and moults about Stewart Island coastline, especially southern coast (Bull et al. 1985).
Mottled petrel	17, 57, 61, 65, 99, 117, 216, 218	Heard calling flight at night. Breeds on some offshore islands of Stewart Island.

sooty shearwater	34, 53, 99, 117, 216, 218	Heard calling in flight at night, and bones found. Small colonies on Stewart Island and large colonies on some off shore islands.
Black shag	93	Seen in Cooks Arm.
Little shag	94, 172	Forages in coastal and inland waters. Widespread about eastern Stewart Island coastline (Bull et al. 1985)
Blue shag		Widespread about Stewart Island coastline (Bull et al. 1985).
White-faced heron	77, 102	Previously reported from Port Pegasus (Bull et al. 1985).
Mallard	69, 93, 118	Seen in estuaries of Port Pegasus
Grey duck	143, 153	Seen at inland wetlands.

Variable oystercatcher	34, 53, 99, 117, 216, 218	Heard calling in flight at night, and bones found. Small colonies on Stewart Island and large colonies on some offshore islands.
Spur-winged plover	93, 94	Not previously reported from Stewart Island (Bull et al. 1985)
Southern great skua	85	Breeds on Stewart Island and its offshore islands (Falla et al. 1985).
Southern black-backed gull	50, 61, 69, 77, 88, 93, 94, 102, 110, 112, 169, 218	Mainly coastal sightings but occasionally seen flying well inland
Red-billed gull	218	Frequently seen in Port Pegasus
Black-fronted tern	100	Occasionally seen about Paterson Inlet (Bull et al. 1985).
White-fronted tern	85, 93, 102, 115, 218	Common about Stewart Island coasts (Bull et al. 1985).

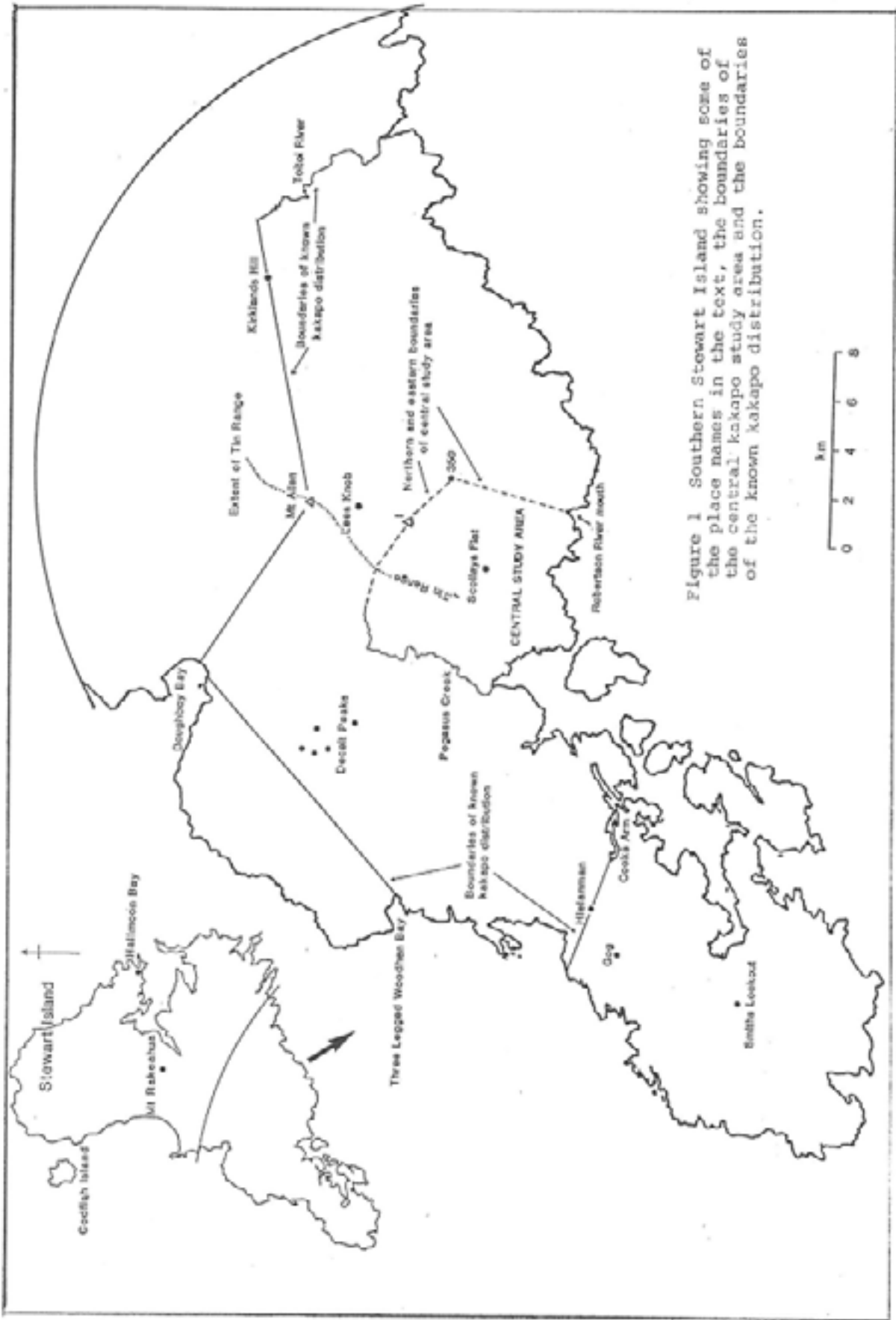


Figure 1 Southern Stewart Island showing some of the place names in the text, the boundaries of the central kakapo study area and the boundaries of the known kakapo distribution.

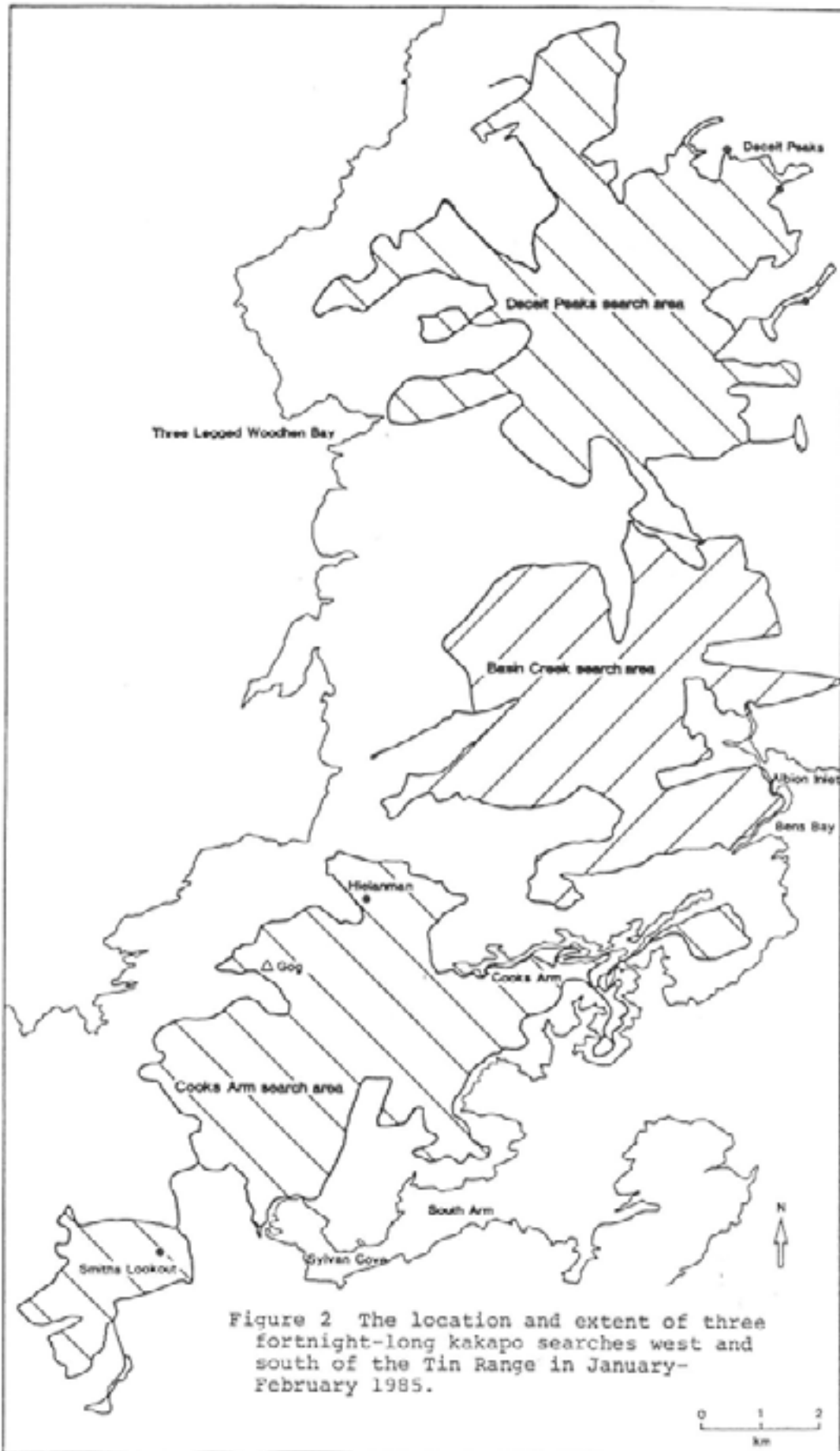


Figure 2 The location and extent of three fortnight-long kakapo searches west and south of the Tin Range in January-February 1985.

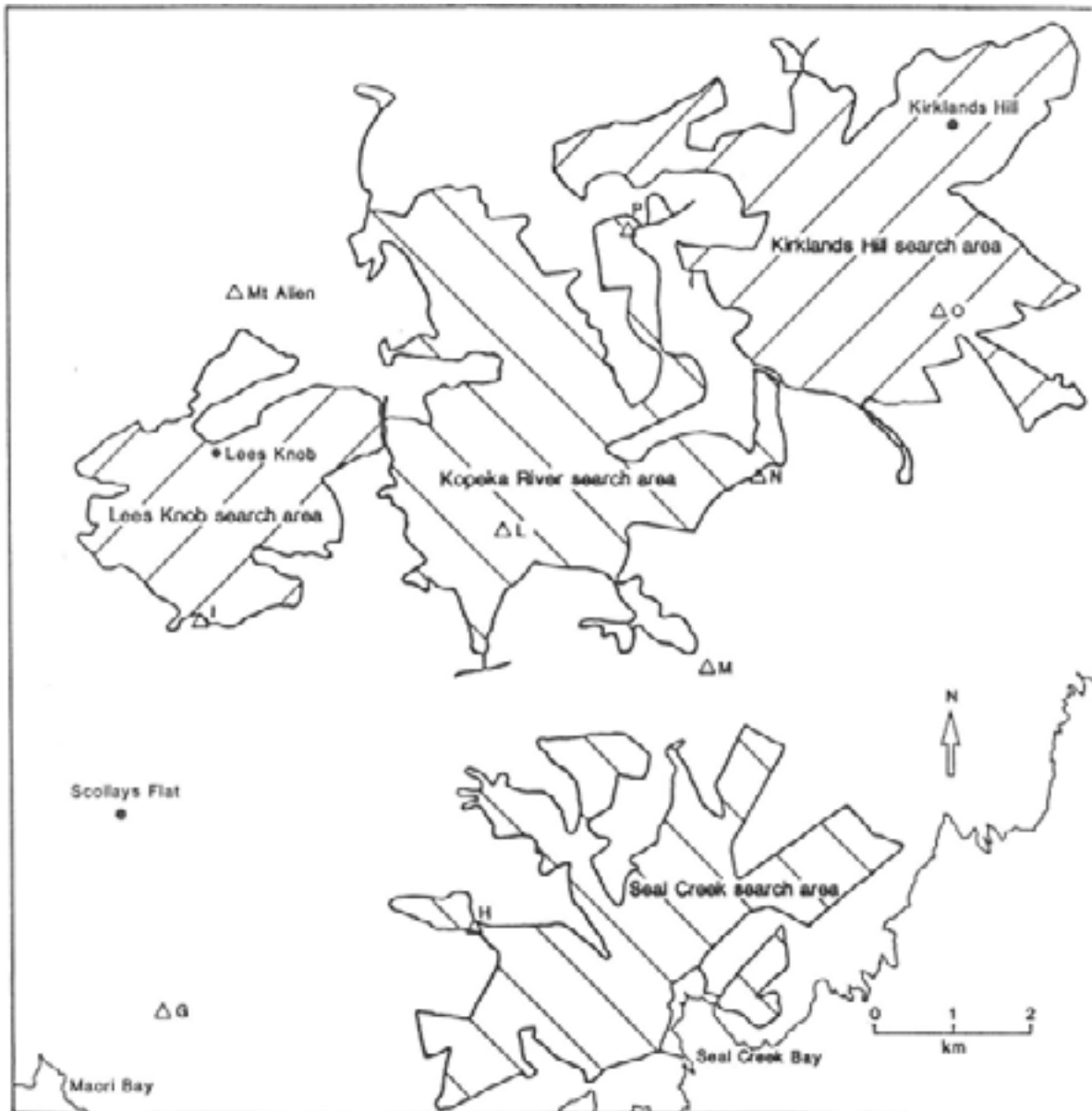
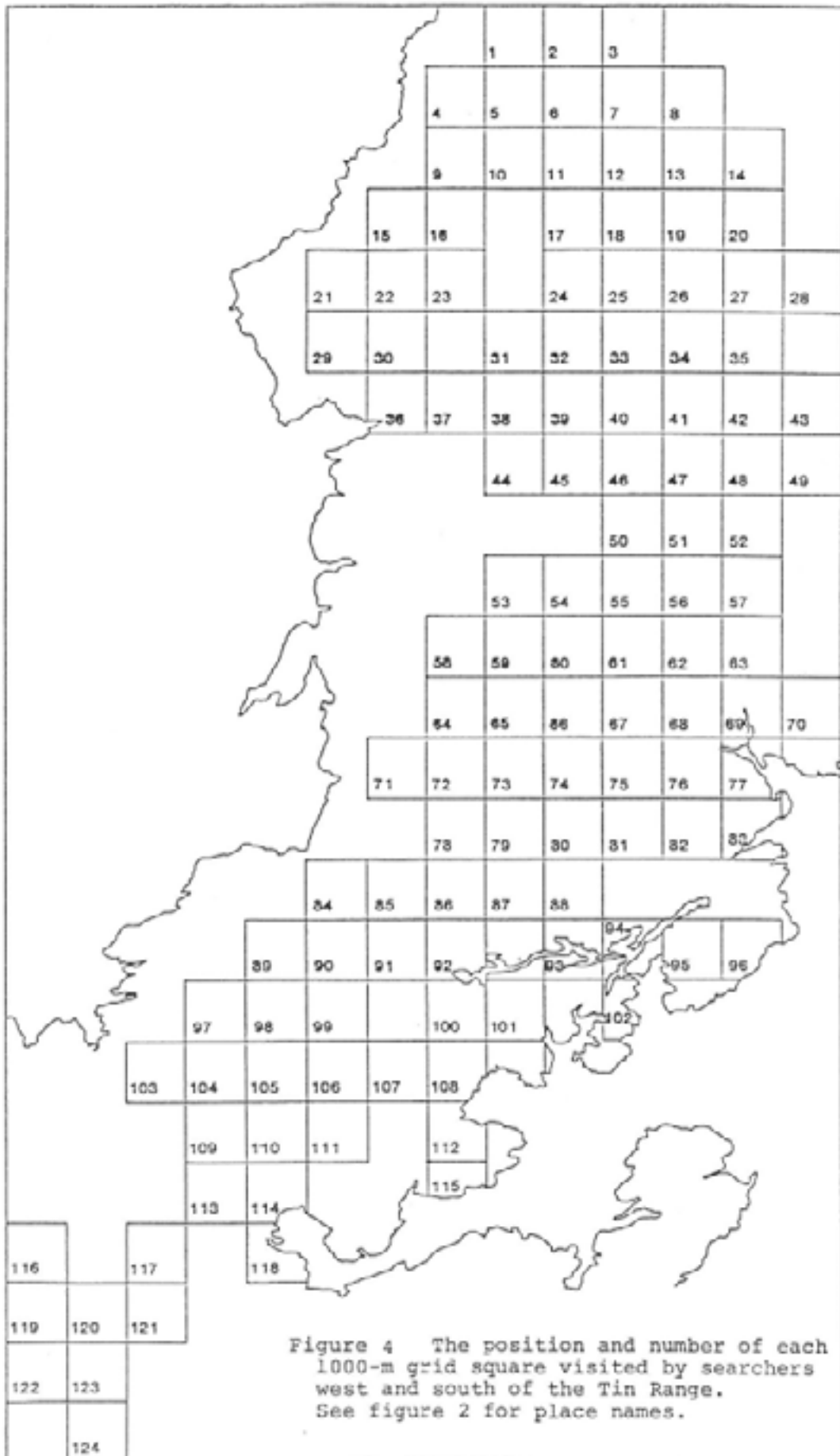


Figure 3 The location and extent of four fortnight-long kakapo searches east of the Tin Range in December 1984 and February-April 1985.



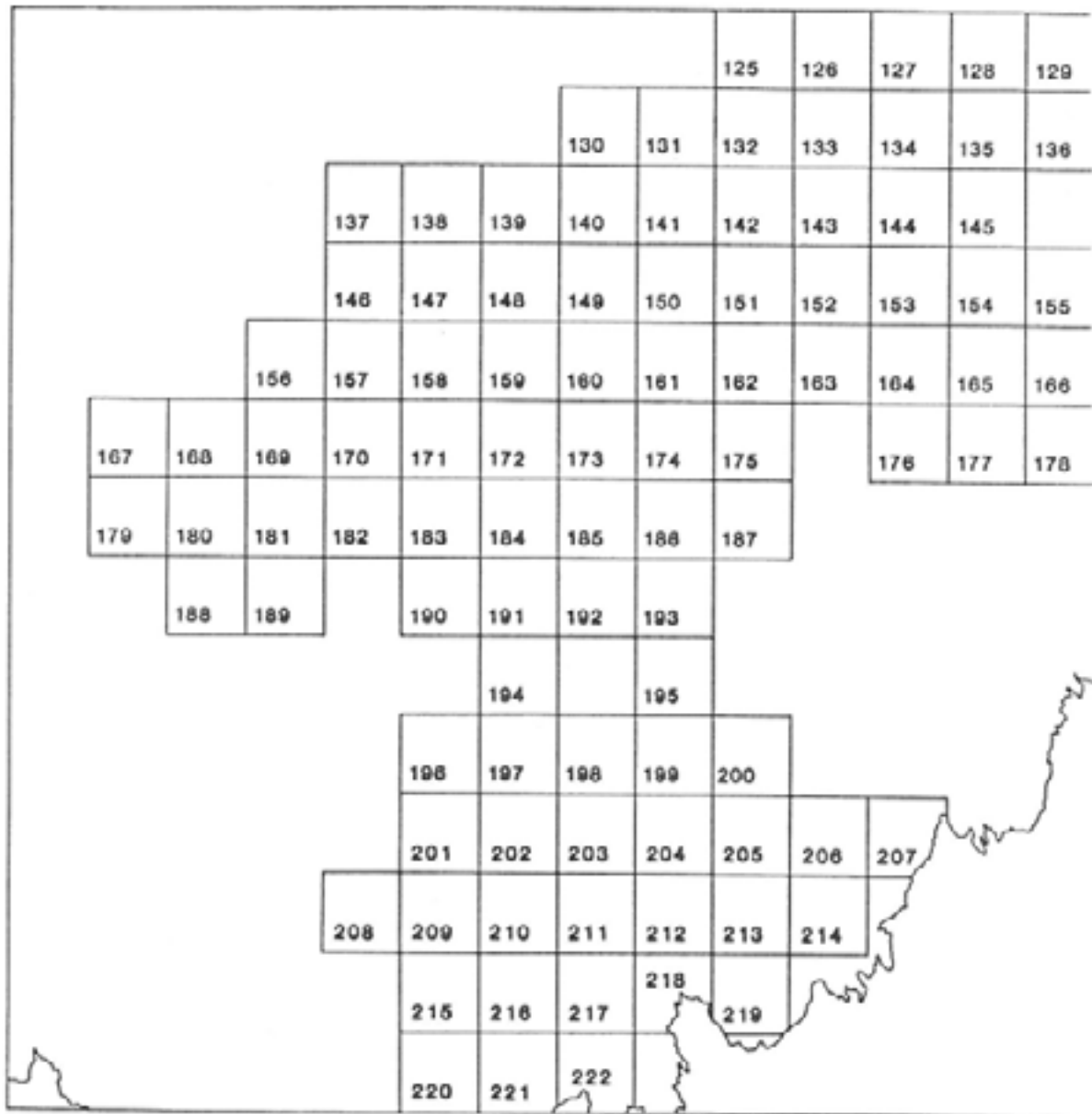


Figure 5 The position and number of each 1000-m grid square visited by searchers east of the Tin Range. See figure 3 for place names.

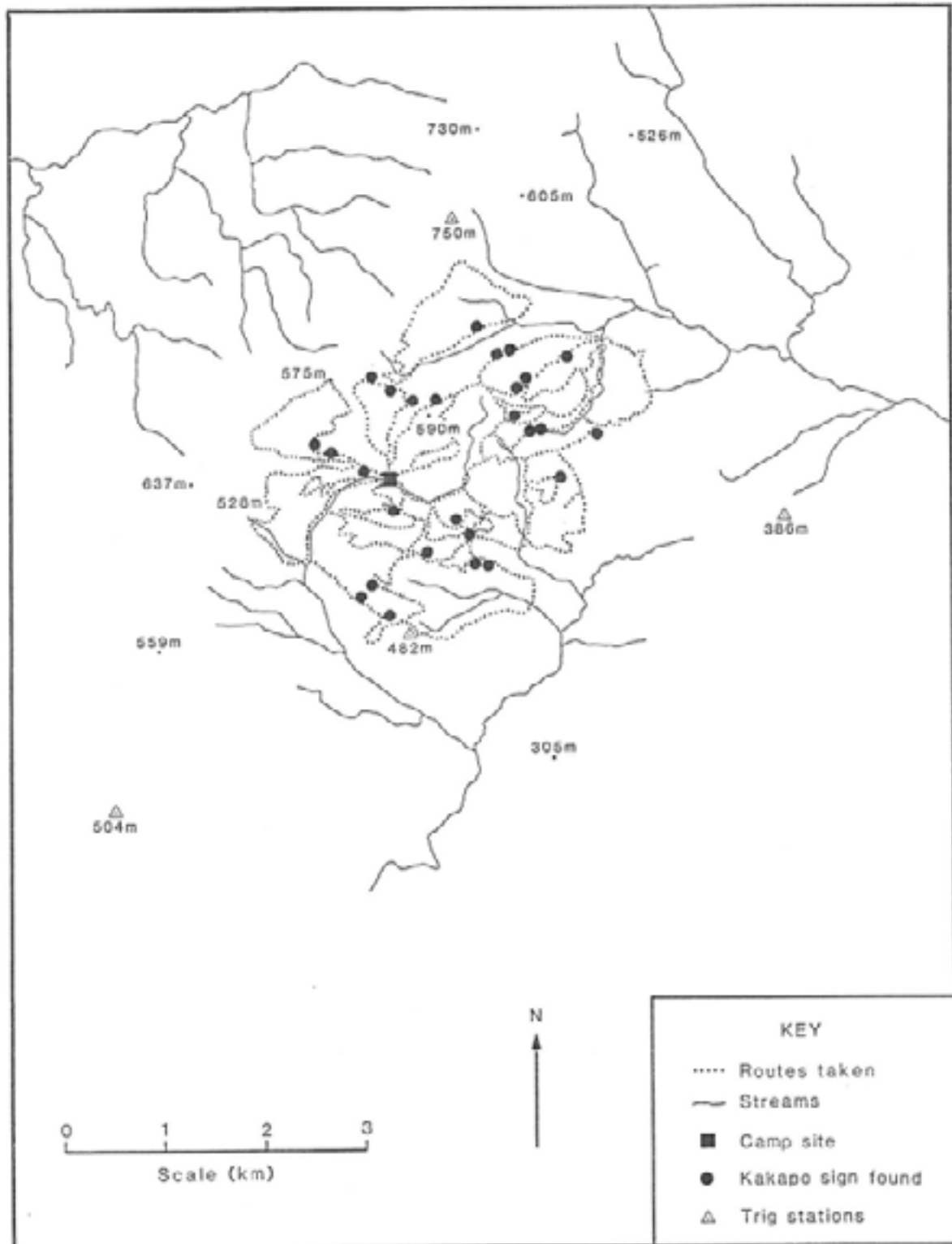


Figure 6 The routes taken by searchers and the positions of kakapo sign found in the Lees Knob search area, 6-20 December 1984.

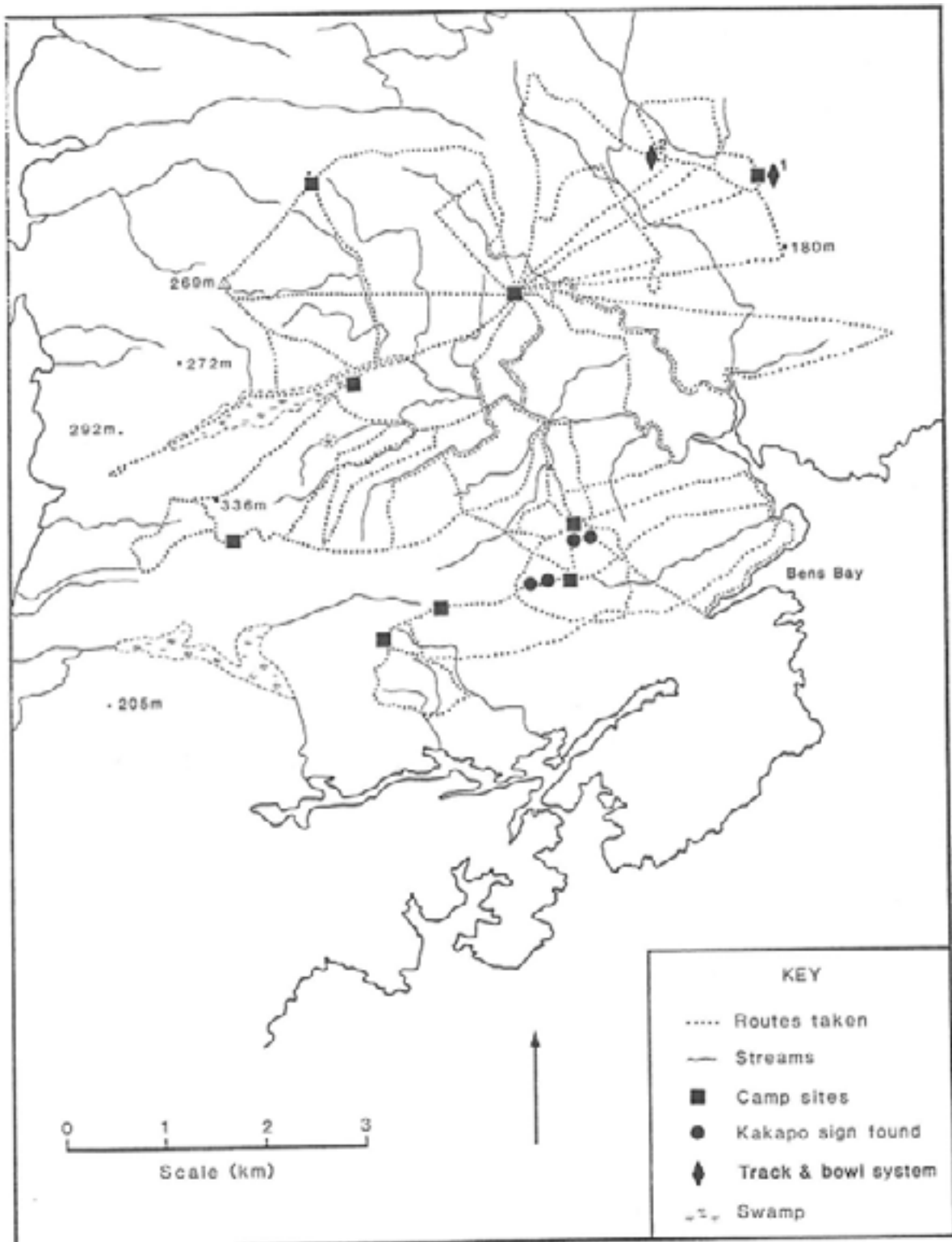


Figure 7 The routes taken by searchers, and the positions of kakapo sign and three track-and-bowl systems found in the Basin Creek search area, 7-22 January 1985.

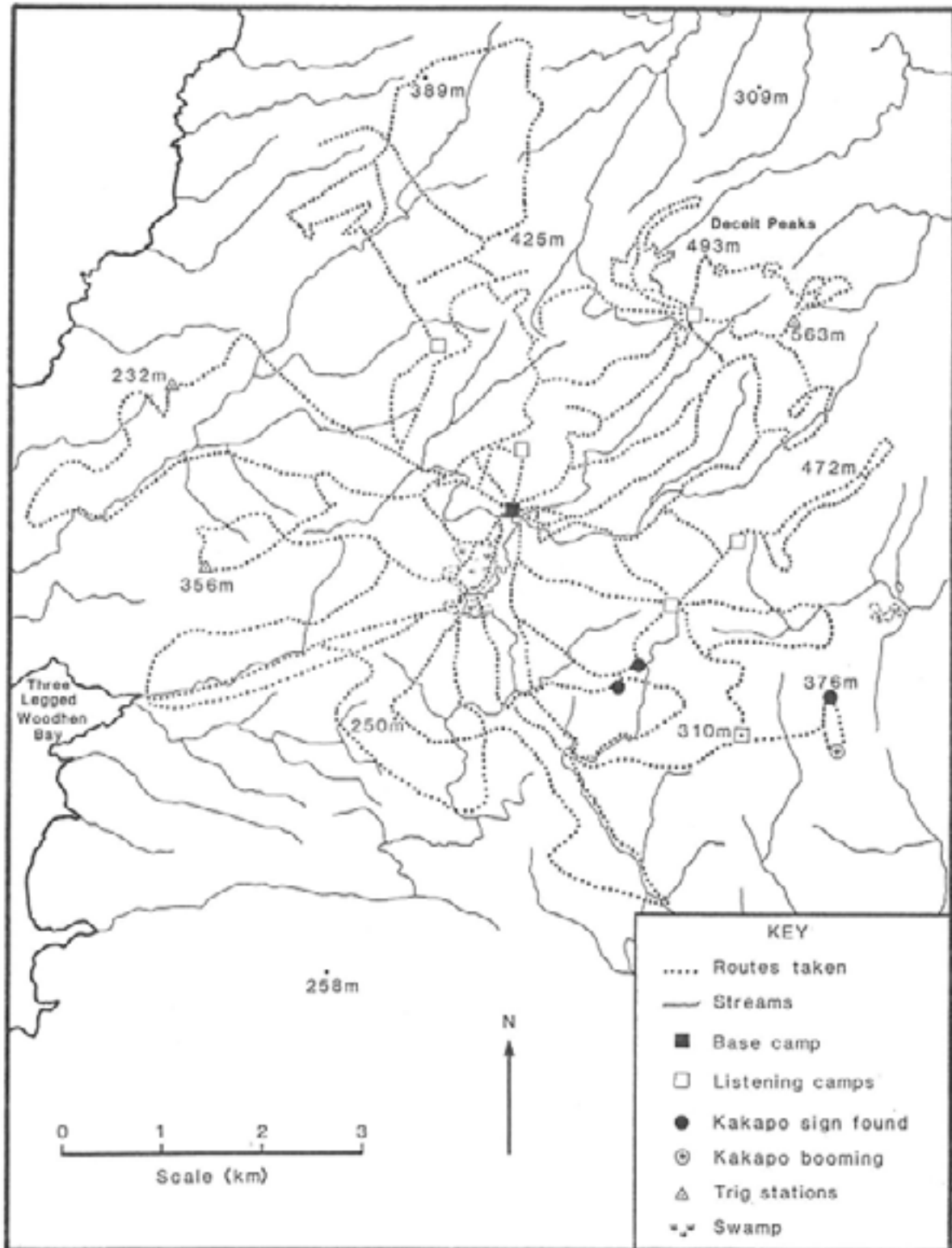


Figure 8 The routes taken by searchers, and the positions of kakapo sign and two track-and-bowl systems found in the Deceit Peaks search area, 22 January-5 February 1985.

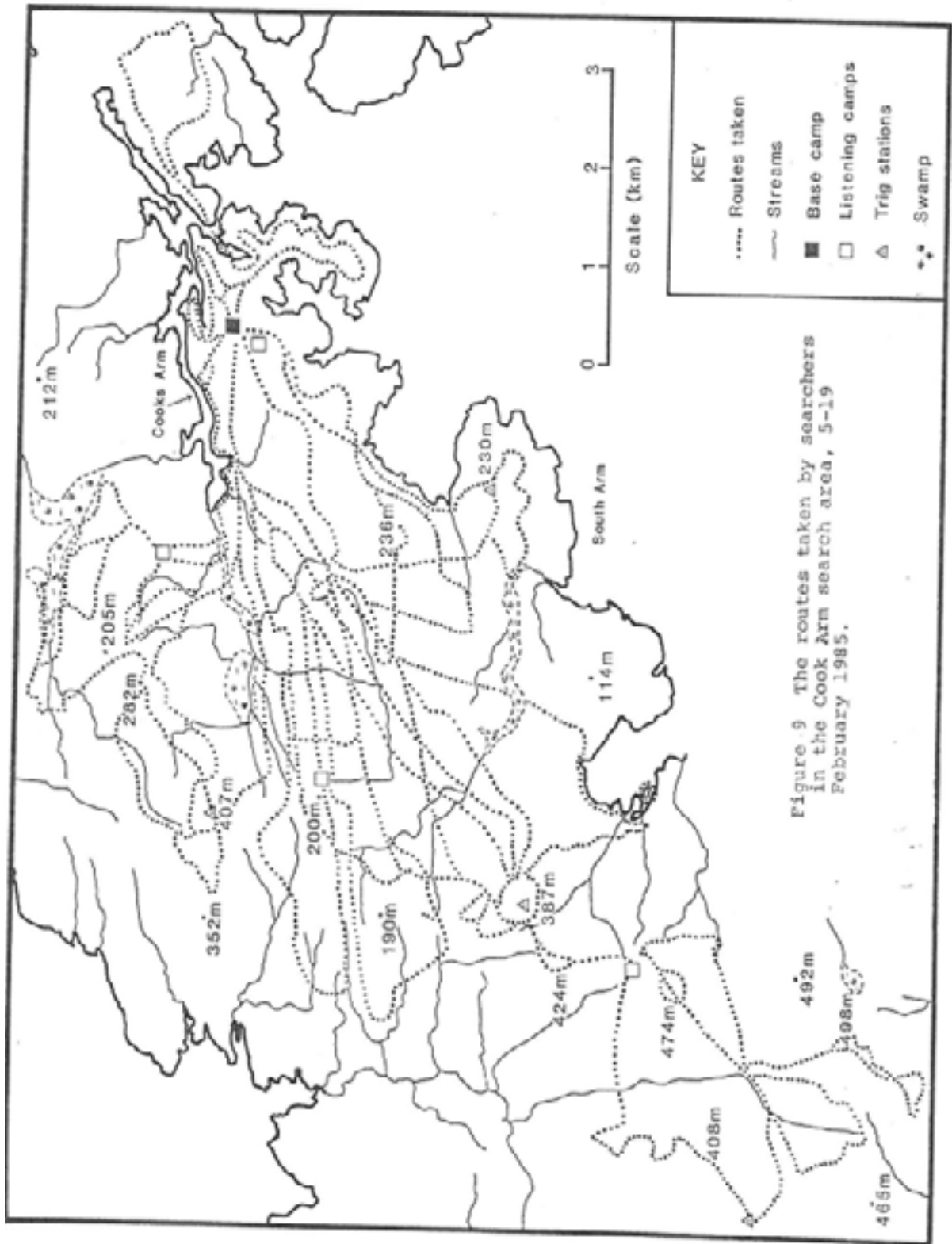


Figure 9 The routes taken by searchers in the Cook Arm search area, 5-19 February 1985.

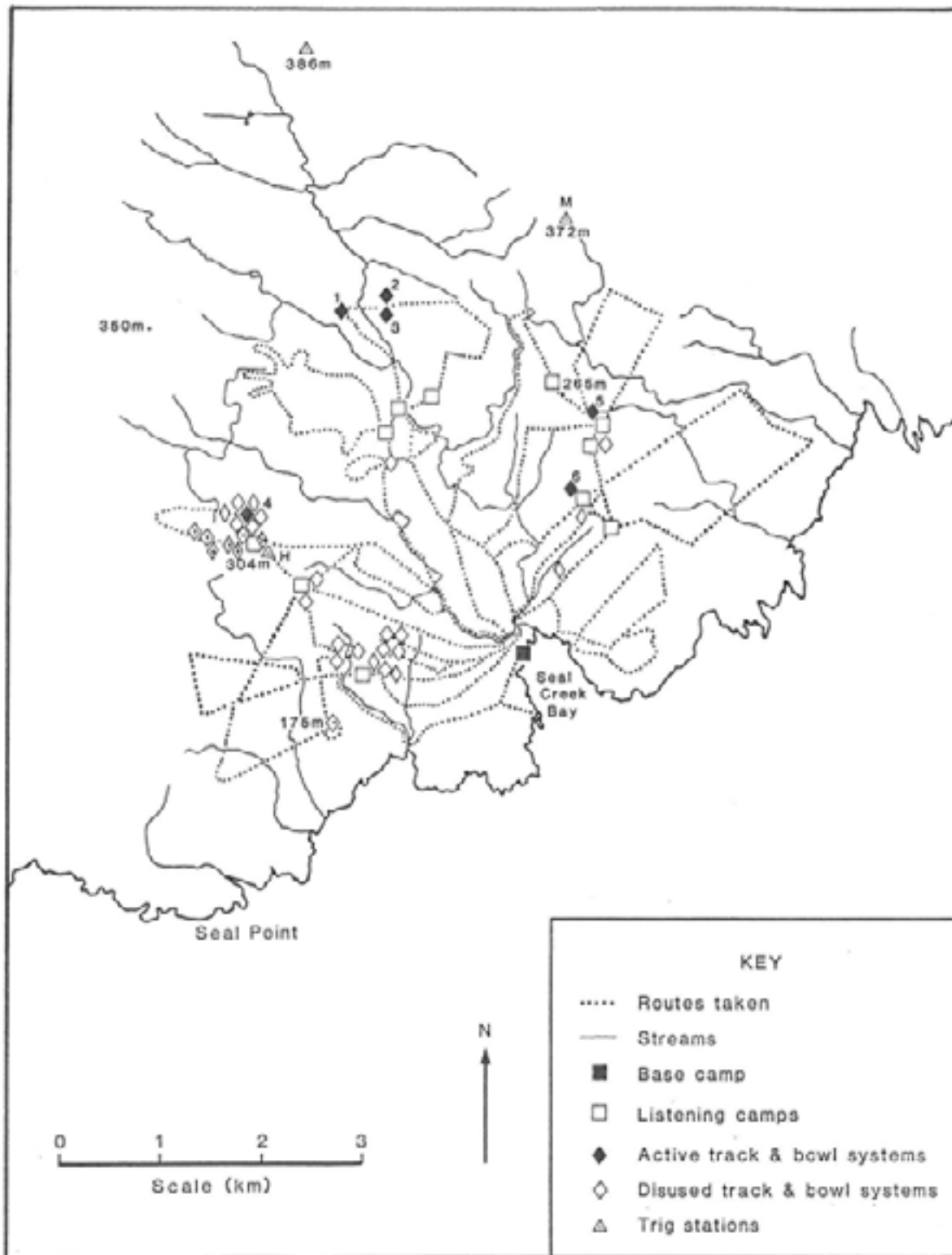


Figure 10 The routes taken by searchers and the positions of 36 track-and-bowl systems found in the Seal Creek search area, 19 February-5 March 1985.

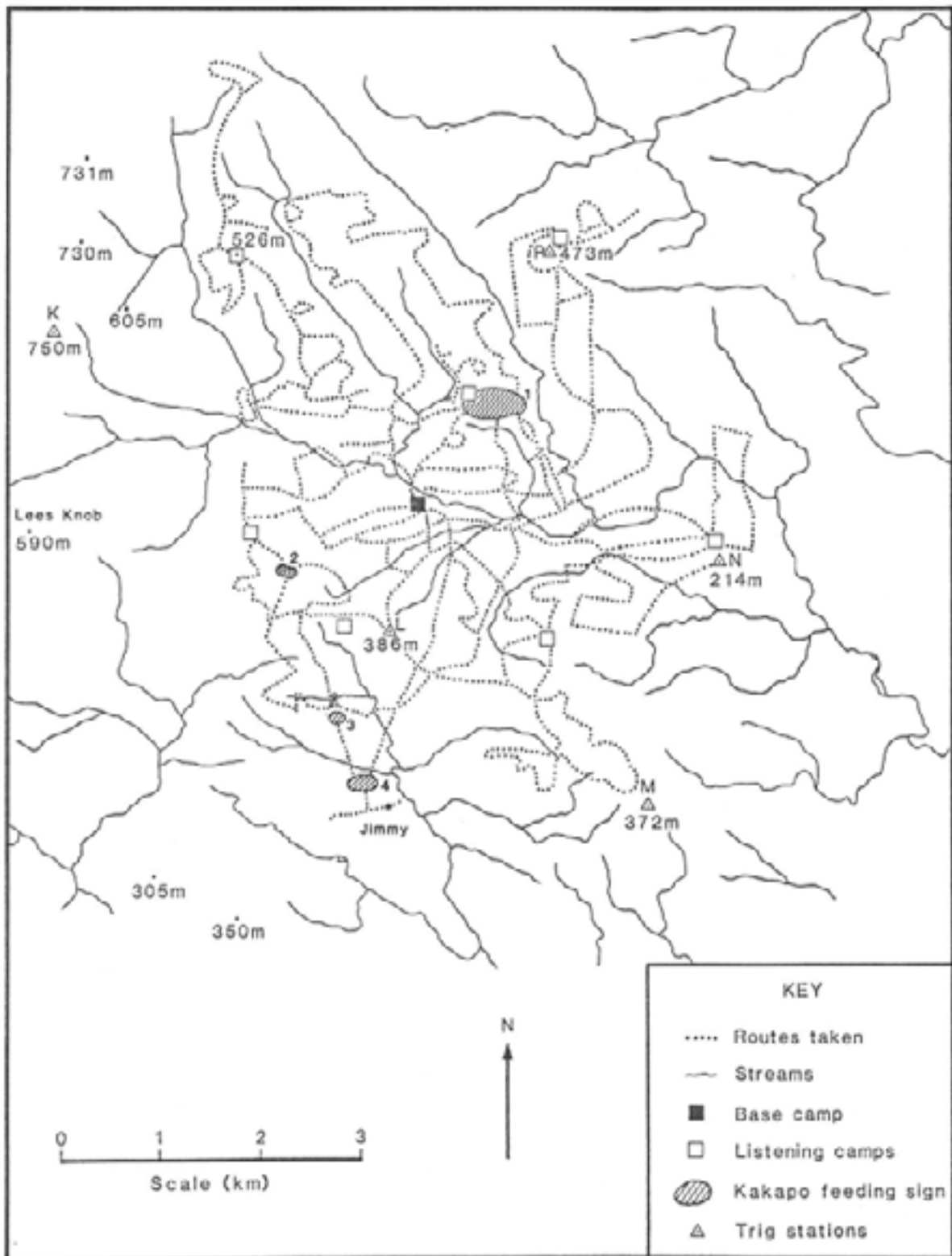


Figure 11 The routes taken by searchers and the positions of four areas of kakapo sign found in the Kopeka River search area, 5-19 March 1985.

