# LIBERATIONS AND DISPERSAL OF RED DEER IN NORTHERN SOUTH ISLAND DISTRICTS

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## ABSTRACT

Data are presented on liberations, establishment, dispersal, and increase of red deer during the period 1851-1968 throughout northern South Island districts. Thirty-two liberations, at 20 places, between 1851 and 1922 of five different strains of red deer, are recorded. Red deer were initially established at Nelson in 1861 from Thorndon Hall stock, England, and later, three comparatively small herds were established near Reefton, Bainham, and Westport from Windsor, Thorndon, and mixed stocks respectively. Distributions are mapped for the period 1861-1900, at decade intervals until 1940, and for the period 1940-68. By 1920 almost 70% of the total area of 14,234 sq miles had been occupied and the remainder was colonised by 1950. Maximum rates of dispersal occurred between 1910 and 1920 at 7 linear miles, or 637 sq miles per year. Prior to 1915, but rarely thereafter, stags were commonly seen outside the range of hinds. Routes and rates of dispersal were influenced primarily by topography and vegetation; in the Marlborough Sounds, Kaikoura region and the Paparoa range a considerable delay in occupation occurred.

## INTRODUCTION

There can be few more outstanding examples of successful acclimatisation of ungulates in New Zealand than that following liberation of three red deer (*Cervus elaphus*) at Nelson in 1861. This paper provides data on the liberation, dispersal, and eruption of red deer populations from Nelson to an east-west line between Greymouth, Lake Sumner, and Cheviot, which are about the southernmost limits to which dispersal of the Nelson herd can be traced. Beyond this, their movement becomes obscured by coalescence with other major herds dispersing northwards.

Background data for a related study on the distribution in the Nelson region of various strains of red deer as defined by their antler characteristics is also provided. Interest which led to this study developed during a 5-year biological investigation of red deer at Cupola Basin, Nelson. Information which would provide an account of occupation and date of increase throughout the study region was collected between 1963 and 1968. The study region and places within it that are mentioned in the text are shown in Fig. 1.

## SOURCES OF DATA

Early publications on liberations and dispersal (Donne, 1924; Forbes, 1924; Thomson, 1922) contain conflicting and imprecise information which stems largely from inadequacies in the original records kept by the various Acclimatisation Societies. Additional information has been derived principally through personal communication with older residents and others who retained memories or notes of worthwhile interest. For this purpose all districts in the study region were visited. Early newspaper articles, little-known publications in museums and private collections, Acclimatisation Societies' records, and unpublished government departmental reports also provided useful information.

## LIBERATIONS

Five different strains of red deer were included in the 32 liberations, at 20 places, which are listed in Appendix 1. The locations and dates of liberations appear on Fig. 2. Private releases of pet deer were also made (e.g., near Motueka and at Tadmor), but as all were of Thorndon strain, liberated within established territory, they are of little consequence. Also it is known that between 1903 and 1907 deer were interchanged between Wakapuaka, Aniseed Valley, Motupiko, and Bainham (Nelson Acclimatisation Society records).

## DISPERSAL

The distribution of breeding populations, compiled from earliest known sight records, are mapped for the 1861-1900 period and thence at decade intervals until 1940 (Figs. 3-7). The sources of these data are given in Appendix 2. Outer limits of distribution are defined from peripheral sight records and negative records of occupation. Where there are no records available at the termination of a decade period, but others in the early years of the following decade, boundaries are interpolated as an informed guess. Records of deer becoming numerous (Figs. 3-7), refer in most instances to earliest known dates of abundance; but in areas of particular interest, e.g., Cupola Basin, later records are also given. Sight records of stags only, at peripheral locations are necessarily considered to be outside breeding population range, since on frequent occasions dispersal of stags preceded that of hinds and younger deer (Figs. 3-5).

The major dispersal routes and subsidiary movements are illustrated in Fig. 8. These, when related to distributions (Figs. 3-7) provide considerable insight into patterns of dispersal and colonisation.

Dispersal began at Nelson soon after establishment in 1861. Distribution probably did not extend beyond ranges to the immediate south and east of Nelson City by 1880. By 1900, deer had dispersed to Pelorus Sound, northern banks of the Wairau River, Tophouse, and Wangapeka Valley; and high densities occurred in the ranges to the immediate south and east of Nelson City (Fig. 3). From 1900 to 1910 there was further colonisation, but growth in this period was marked mainly by a consolidation and increase of population over the 1900 distribution area (Fig. 4).

By 1920, the area of colonised range, and impressions of population size, had increased dramatically; deer extended to Hanmer — Lake Sumner — Ahaura — Westport — Karamea — Takaka — Nelson — D'Urville Island — Blenheim — Ward

and to the Inland Kaikoura range (Fig. 5). Herds from the Crushington and Lower Buller liberations had coalesced with the Nelson herd. Continued expansion and population increase throughout the 1920s resulted in the coalescence of Nelson and Bainham herds and that of the Poulter herd (Logan and Harris, 1967) with Nelson deer on the study's southern boundary. Those areas not occupied by 1920, i.e., the outer Marlborough Sounds, eastern coastal regions of North Canterbury and Marlborough, coastal North-West Nelson and the Paparoa range (Fig. 6) were colonised between 1930 and the 1950s, the most recent being offshore islands of the Marlborough Sounds (Fig. 7).

Though outside the scope of this study, it is interesting to note the occurrence after 1930 of a northerly movement of deer from the Poulter herd to south-eastern regions of the study area. This will be discussed in a later paper.

## RATE OF SPREAD

The area occupied by breeding populations of the Nelson, Crushington, and Bainham herds and the total of those areas measured from mapped distributions (Figs. 3-7) are shown in Table 1. Rates of spread, summarised in Fig. 9 and Table 1 are calculated from these measurements and from measurement of linear distances travelled. Linear rates are measured as the distance between liberation point, or last known distribution, and the furthest known breeding population, divided by the number of years elapsed

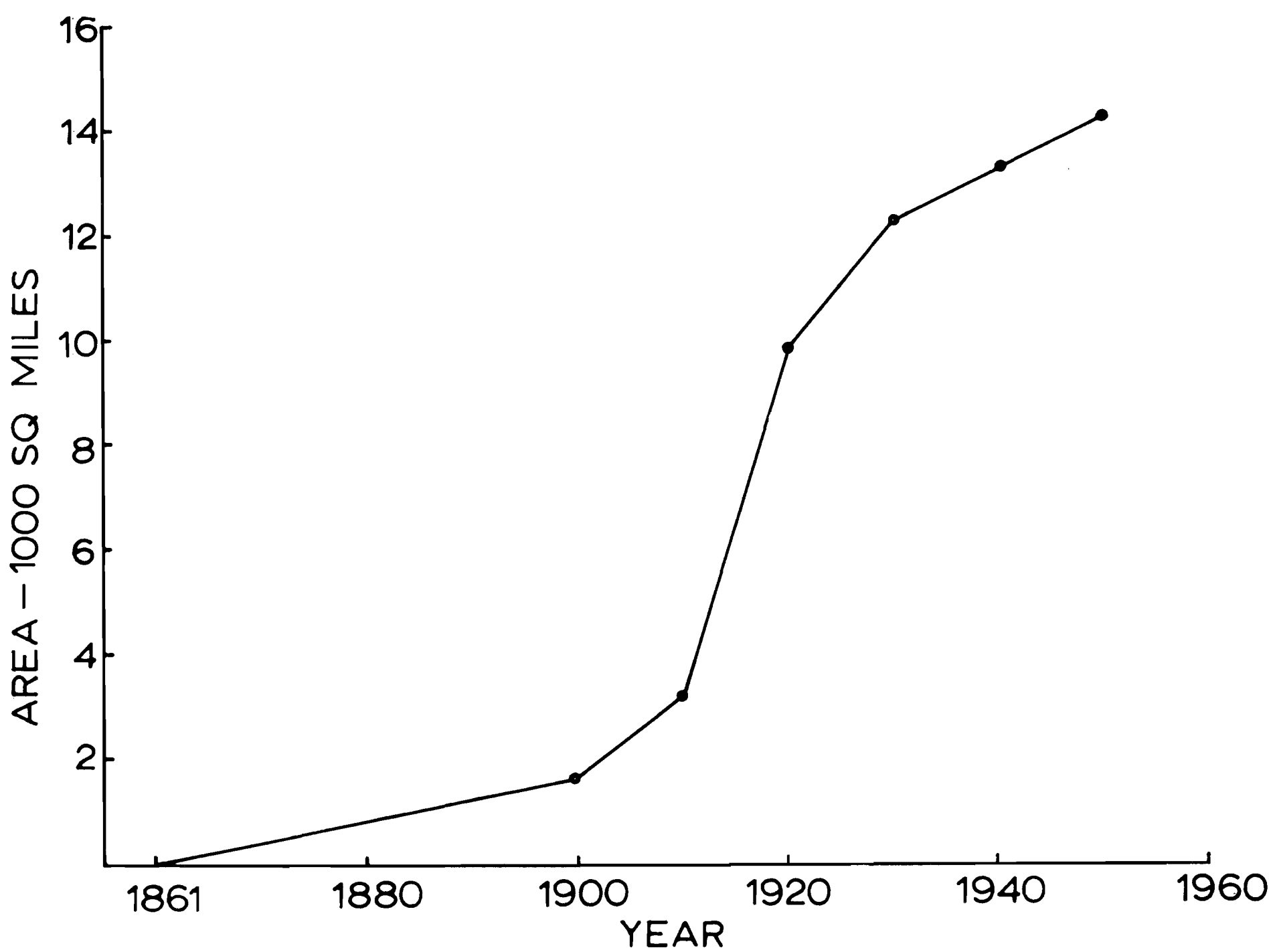


FIG. 9—Rate of spread of red deer in northern South Island districts.

**TABLE 1—Area occupied and rates of dispersal of the Nelson, Crushington, and Bainham herds, 1861-1950.**

| Dispersal measured: yr | Herd liberated at: NELSON (1861) Area occupied sq miles | NELSON (1861) Maximum linear rate miles/yr | NELSON (1861) Areal rate sq miles/yr | CRUSHINGTON (1898) Area occupied sq miles | CRUSHINGTON (1898) Maximum linear rate miles/yr | CRUSHINGTON (1898) Areal rate sq miles/yr | BAINHAM (1906) Area occupied sq miles | BAINHAM (1906) Maximum linear rate miles/yr | BAINHAM (1906) Areal rate sq miles/yr | All herds after coalescence: Maximum linear rate miles/yr | All herds after coalescence: Areal rate sq miles/yr | Total area occupied sq miles |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1900 | 1,644 | 1.0 | 42.1 | Liberation area only | | | | | | | | 1,644 |
| 1910 | 3,040 | 2.7 | 139.6 | 24 | 2.0 | 0.1 | 73 | 3.9 | 18.2 | | | 3,137 |
| 1920 | 9,438 | 7.0 | 637.4 | Coalesced | | | 371 | 1.2 | 29.8 | | | 9,809 |
| 1930 | Coalesced | | | | | | Coalesced | | | 2.0 | 241.7 | 12,226 |
| 1940 | | | | | | | | | | 0.8 | 97.4 | 13,200 |
| 1950 | | | | | | | | | | 0.8 | 103.4 | 14,234 |

(Caughley, 1963). Similarly, areal rates are measured as the area occupied by breeding populations since liberation, or last measurement, divided by the number of years elapsed.

Both the linear distance moved and area occupied indicate that as colonisation progressed and herd range expanded, the absolute increase in distance dispersed and range occupied exceeded a constant exponential form. Up to 1900, dispersal was relatively slow and deer occupied 1,600 sq miles; then dispersal accelerated so that by 1910 they occupied 3,100 sq miles and by 1920, 9,800 sq miles. The rate of spread slackened some time near 1930, probably because most available land was occupied. This pattern suggests either change in the rate of increase of population, or a change in the colonising behaviour of the deer, during the middle part of the period of dispersal through the region.

## DISCUSSION

The absence of major peripheral liberations which would mask the main pattern, renders the Nelson herd particularly suitable for a study of dispersal. Only those liberations occurring outside the distribution area of the Nelson herd, namely at Crushington, Lower Buller, and Bainham, had any effect on dispersal and colonisation and detailed knowledge of their growth and dispersal eliminates the possibility of records becoming confused with those of the Nelson herd. In comparison these were minor herds at the time of coalescence. Furthermore, evidence from a related study of antler characterics, suggests that the territory colonised by the Crushington and Lower Buller herds was rapidly infiltrated by Nelson deer after coalescence. As the Bainham liberation was a transplant from the Nelson herd, a similar index cannot be applied.

### *Patterns of Dispersal*

The pattern of dispersal warrants particular comment. In accordance with described patterns of red deer range occupation, apart from the period of the rut, mature stags are segregated from hinds and younger deer (Darling, 1956; Darling, 1952; de Nahlik, 1959). These authors suggest that segregation reflects different social and physiological requirements for the two sexes, resulting in hinds and younger deer occupying relatively warm sheltered areas, and stags seeking higher range in colder, more rugged areas. The pattern described, that for European red deer herds, resembles that which occurred in the study area during early stages of establishment.

Initially, stags extended territory by occupying new areas; hinds and younger deer followed later. Davidson and Kean (1960) and Wilson (1963), also note similar movement among New Zealand red deer herds in the Tararua ranges and western Otago respectively. Exceptions to the standard pattern did occur, but these were confined to isolated individuals, for example, a hind was observed at Kekerengu in 1916-17 (Fig. 5), but no other deer were present until 1930 (Fig. 6).

Prior to 1915, some stags were usually observed far outside the limits of range occupied by hinds (Figs. 3-5). Stags preceded hinds in the Buller region by 3 to 12 years, and on one occasion by 55 miles (Fig. 3). Though the overall distribution of stags outside breeding range was sparse, the D'Urville and Sabine valleys, apart from during

the rutting season, held large numbers 1 to 3 years prior to occupation by hinds (N. McConachie, pers. comm.). Following 1915, except in the Paparoa range, stags were rarely seen beyond the limits of the breeding population. The reason postulated for this change is that, whereas prior to 1915 large areas potentially suited as stag range were unoccupied, rapid herd expansion after 1915 resulted in hinds and younger deer occupying most of the former and potential stag range. Consequently, lateral movement of stags beyond breeding populations became increasingly restricted as colonisation proceeded. In the montane areas stags continued to segregate, but vertically rather than horizontally. The impression of rapid herd growth, resulting in enforced integration, is supported by the one exception to the general trend; this being in the Paparoa range area where, as the result of a slow rate of spread and increase, the earlier pattern of advance dispersal by stags prevailed until the 1940s (Figs. 5-6).

During colonisation (1861-1930) the herd consisted of two distinct density zones: (1) a peripheral zone sparsely populated, initially and at first by stags only (but after 1915 by integrated groups) and in their rear scattered hinds and younger animals, and (2) an inner, more dense zone populated by the bulk of the breeding population. Often as the result of expansion of the breeding population density declined within formerly heavily populated areas, but population soon increased again unless the area had been overstocked. For example, at Tophouse and Glenhope, deer became relatively scarce 1-3 years after the initial increase, but within a decade were once again plentiful.

The lapse of time between initial occupation and the date when deer became numerous varied in different areas, but generally was shorter after 1910. On such major dispersal routes as the Upper Wairau valley (Fig. 8) deer became plentiful within 4 years of initial occupation. Conversely, in areas of the Marlborough Sounds where sounds and channels impeded direct dispersal, there was no significant increase until up to 20 years after the first deer were reported.

The breakdown of dispersal rates into decade periods (Table 1) illustrates the various phases of growth and expansion of the Nelson herd. Before 1900, during initial increase and consolidation of population, dispersal averaged 1 linear mile or 42 sq miles per year. Peak rates, parallel with large population increases, occurred from 1910 to 1920 at 7 miles, and 637 sq miles per year. Following 1920, dispersal slowed to 2 miles and 241 sq miles per year for by then few areas remained uncolonised.

Riney *et al.* (1959) estimate the rate of dispersal of red deer over a period of about 30 years in south-eastern Fiordland to be approximately one linear mile per year. In a comparison of dispersal rates, over periods exceeding 50 years, of nine species of ungulates introduced into New Zealand, Caughley (1963) ascribes highest rates to chamois at 5.4 miles per year and places the Nelson herd of red deer third at 1.0 mile per year between 1851 and 1924. An estimate made by Christie (1964) for dispersal of chamois, of about 6 miles per year over 33 years is based upon more accurate information. The data on which the estimation by Caughley (op. cit.) for red deer is based (Donne, 1924; Forbes, 1924; Wodzicki, 1950) have been eclipsed by the findings of this study, and the assumption that the 1851 liberation was successful has been proven erroneous. Considering the present data it is evident that between 1910 and 1920 the rate of dispersal of red deer exceeded that recorded for chamois.

*Factors Influencing Dispersal*

Topography and vegetation heavily influenced both route and rate of dispersal. The occupation of the lower Clarence River valley, Kaikoura region, and other areas illustrates this point.

Despite the generally rapid movement southwards (beyond Hanmer by 1916) (Fig. 5) deer were not seen below the Clarence River-Elliot Stream confluence until 1919 and then only occasionally for many years after. Sixteen years after the first was sighted, moderate numbers appeared, dispersing both up river and down river from the Hodder-Medway Rivers and Lake McCrae areas respectively (Fig. 7). Between these points dispersal was barred by the 7,000-9,465 ft Inland Kaikoura range. It is curious to note, however, that despite high populations present on adjoining Molesworth Station during the 1920s, deer did not become plentiful in the Clarence River area (i.e., below Quail Flat) until after 1936. High numbers of sheep and goats probably influenced this delay.

The coastal Kaikoura regions reflected a similar pattern of occupation to that of the Clarence Valley. There, colonisation occurred from both north and south via the Kahutara and Clarence River valleys, the two movements of deer meeting in the region of Puhipuhi River about 1930. Although the high altitudes of the Seaward Kaikoura range may also have barred direct dispersal, the pattern was primarily a consequence of the flanking movements around high regions of the Inland Kaikoura range.

In contrast to the rapid movement southwards, dispersal in the Marlborough Sounds was slow. Deer were first sighted at Tennyson Inlet in 1898 (Fig. 2), yet eastern headlands 28 miles away were not colonised until the 1940s (Fig. 7). The nature of the land, dissected by sounds and channels, undoubtedly influenced this delay. Even though deer displayed no reluctance to swim intervening channels, there was apparently little desire to do so, except when chased by dogs, until high densities initiated further dispersal. Without hunting by dogs, which would have had a limited, nonetheless important effect (since deer were often forced to swim channels to escape), colonisation may have been delayed even longer.

The utilisation of suitable tides by deer, particularly during colonisation, facilitated crossings to adjacent land. At French Pass deer were frequently observed congregating on beaches, then entering the water on receding tides, to be swept to the coast of D'Urville Island (T. Wells; B. W. Woodman, pers. comm.). Strong currents between mainland peninsulas and offshore islands probably resulted in the diversion of many animals to alternative landfalls. The occupation of the Chetwode and Rangitoto Islands, 2 miles from adjacent land and isolated by strong currents, could thus be explained. However, the presence of deer swimming in open sea and towards no visible landfall, as observed at Cloudy Bay and east of D'Urville Island respectively 7 and 11 miles from the nearest land (J. R. Eyles; C. N. Harvey, pers. comm.) suggests that deer are easily able to negotiate shorter distances.

In addition, dispersal was retarded by land settlement and high stock densities on narrow peninsulas in the Marlborough Sounds; for example, although in 1900 deer were present south of the isthmus separating Elaine Bay and Croisilles Harbour, none was seen further north until 1917 (Figs. 3-5). Similarly, at Manaroa-Waitaria Bay, deer were not sighted on Mt Stokes until 1929, yet were present to the immediate west of the settled land in 1920 (Fig. 5).

The pattern of occupation and increase of population in the Paparoa range are altogether unique in the region investigated. All information suggests that the area is comparatively unfavourable to deer; a series of factors, the most obvious being local and periodic high populations of fallow deer and goats, difficult terrain, and dense forest resulted in slow, sporadic colonisation and a slow rate of increase. Red deer have rarely been sighted in groups of more than 10 and groups remain sparsely scattered, reminiscent of early stages in the pattern of establishment of deer range, but in a near stationary state of growth. Highest numbers occurred between 1960 and 1965.

Parallel road and rail communications in the Seddon-Ward and Oaro-Cheviot areas delayed colonisation of lands to the east. Areas to the immediate west of each were occupied by 1925 but the east was not colonised until 10-18 years later.

The importance of dispersal routes as an accelerating influence upon dispersal is well illustrated by the rapid expansion of the Nelson herd between 1910 and 1920. The large advances occurring during that period in south Nelson, inland Marlborough, and Karamea districts were primarily due to rapid movement along the major dispersal routes, i.e., the Upper Wairau, Awatere, and Wangapeka Valleys. During 1916, in the upper Wairau Valley, following a period when few deer were seen, mobs of 30 or more appeared dispersing southwards; except during the winters, this movement continued unabated until 1920 when the population was consolidated (J. T. Solomon, pers. comm.). However, in some contiguous valleys (e.g., the Leatham and Branch), deer did not become plentiful until 8-11 years later (Fig. 6). This reinforces the impression of accelerated movement along dispersal routes.

Of the two dispersal measurements, areal or linear, the former probably provides a better insight into the overall rate of spread. This arises through non-uniform linear dispersal (mainly southerly orientated) which tends to mask the rate of spread in other directions. Had dispersal been uniform, it is postulated that linear rates, although lessened, would have been maintained at a relatively high level since high rates occurred primarily as the result of particularly rapid herd growth.

The data, in addition to substantially increasing known rates of dispersal for ungulates introduced into New Zealand, indicate that between 1861 and 1920 spread extended with increase in density in a manner quite different from that expected from a simple exponential rate. Reasons for that are not established beyond doubt, but, since breeding success was very high in the early years (at least 37% between 1861 and 1870, Clarke, unpublished data) change in the rate of spread independent of population density is a reasonable conclusion. Evidence that individual animals travelled great distances once they left forested areas and entered open inland grasslands substantiates that conclusion. Red deer were first sighted in the Rainbow River forests in 1911, then appeared at Hanmer, 31 miles away across the Molesworth-Tarndale grasslands within 2 years. That amounts to dispersal of 15 miles per year, more than twice the average of 7.0 miles per year between 1910 and 1920 and suggests that had not most inland grassland deer range immediately south of the Hurunui River been occupied by the Poulter herd of red deer by 1920, the rate of spread may have continued to rise.

## CONCLUSIONS

One of the most striking observations made during this study was the far greater rate of increase in the newly liberated Nelson herd compared with that of long established red deer. This may be attributed to the absence of the normal pressures imposed by factors such as limited food supplies and hunting.

The early establishment of non-uniform dispersal is a topographically controlled feature. The deer travelled along river valleys giving easy access to the preferred habitats of the montane areas. As a result, the major valleys of Nelson leading south into the inland ranges were the first colonised; they imparted a marked southerly orientation to the initial dispersal pattern. As the deer encountered different habitats of varying favourability, there were associated differences in the rate of colonisation. The increase in dispersal rate apparent in the data reflects the greater speed of travel shown by individual deer once they moved from forest into grasslands resulting in the overall deviation from a constant exponential rate. This cannot be interpreted as a rise in the rate of population increase as dispersal proceeded.

The distinctive pattern of stags preceding hinds and young deer in the early stages of dispersal appears to be the result of sociological and physiological differences in behaviour, with the stags actively seeking separation from the hinds out of the rutting season. Later, when all favourable areas have been colonised, this tendency is expressed in a vertical segregation of the stags in the higher, more exposed country and the hinds in the lower and more sheltered habitats.

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## APPENDIX 1

### Liberation and Establishment of Red Deer Herds

**1. Maitai Valley, Nelson**

1851: One stag and one hind from Thorndon Hall, Essex (Donne, 1924).
Establishment—Unsuccessful. Recent research has placed considerable doubt on the timing and details of this liberation, as reported by Donne (1922). It is intended to clarify these points in a later paper.

**2. Waimea River Mouth, Nelson**

1854: One stag from Royal Richmond Park, England (The Colonist, 6/9/1854). Donne (1924) reports that a hind shipped with the stag died en route.
Establishment—Sometime after 1854 this stag was transferred from liberation area to Brook Stream (near Nelson) where it remained until 1861 (The Examiner, 20/2/1861. Although its disappearance coincides with the 1861 liberation, there is no evidence to suggest that it joined that herd. It had not done so by 1863 (The Examiner, 3/12/1863).

**3. The Grampians, Nelson City**

1861: One stag and two hinds from Thorndon Hall (The Examiner, 22/2/1861; Donne, 1924).

Establishment—This was the first successful liberation. By 1863 the herd had increased to seven animals (The Examiner, 3/12/1863) and in 1870 over 50 were present (The Examiner, 19/3/1870). These deer formed the "Nelson herd" whose progeny subsequently dispersed throughout the study area.

**4. Cheviot Hills, Cheviot, North Canterbury**

1868 (About): An unknown number liberated by North Canterbury Acclimatisation Society (Donne, 1924), presumably Windsor stock from Victoria. Lamb (1964) records that in 1868 Mr J. S. Caverhill of Cheviot obtained a stag, but it is not known if it was liberated.

Establishment—The liberation failed. Mrs A. M. Hyde (pers. comm.) recalls that the last of the liberated animals was shot about 1880.

**5. Glens of Tekoa, Culverden, North Canterbury**

1884 (About): One stag and one hind from Australia, plus one stag from Nelson (T. R. Henshaw, pers. comm.).

Establishment—The hind and the imported stag died soon after liberation (D. L. Rutherford, pers. comm.); the remaining stag was later shot (Donne, 1924).

**6. Swyncombe, Kaikoura**

1888 (About): An unknown number liberated, obtained from Christchurch (E. A. Reiher, pers. comm.).

Establishment—Deer were present at Swyncombe until approximately 1900, but destroyed soon after (Reiher, pers. comm.).

**7. Upper Takaka, Golden Bay**

1892: One stag and one hind (presumably Thorndon strain) on Beardmore's property, west bank Takaka River (W. C. R. Sowman, pers. comm.).

Establishment—Presumably unsuccessful, because in 1900 the Nelson Acclimatisation Society stated its intention to liberate a further stag and two hinds on the same property. Since it is known that the hills about the liberation area were not colonised until 1910, it is unlikely that the liberation was successful or that the second intended liberation occurred.

**8. Langleydale, Marlborough**

1898: Approximately eight of mixed age and sex, Thorndon strain from Nelson (Mrs A. M. Adams, pers. comm.). Earlier, in 1892, one stag and two hinds were transferred from Nelson, but they and their progeny were retained in the Langleydale pens until 1898 (Adams, pers. comm.).

Establishment—These deer were liberated as the "Nelson herd" occupied the northern banks of the Wairau River and it is thought that they integrated with this herd and dispersed to the south bank of the Wairau. In 1922, an old stag bearing a Langleydale eartag was shot near Wye River (C. N. Harvey, pers. comm.), but it is believed that this was from a later release, as occasional fawns were captured, tagged, and released after 1898 (Adams, pers. comm.).

**9. Crushington, Reefton**

1898: One male and two female fawns of Windsor strain from Wairarapa, liberated by Messrs S. and J. Ross (W. Blackadder, pers. comm.).

Establishment—Remained at liberation point for approximately 5 years before dispersing up the Inangahua valley and to the Victoria range (Blackadder, pers. comm.).

**10. Nelson area (probably Hira)**

1889: One stag of Invermark strain, Scotland (Donne, 1924). Mr Percy Adams offered to liberate the stag on his property at Hira; it is not known whether this occurred.

Establishment—Shot approximately one year after liberation (Nelson Acclimatisation Society records).

**11. Hapuka River, Kaikoura**

1900 (About): One stag and one hind, obtained from Christchurch, liberated by Mr E. Parsons (E. A. Reiher, pers. comm.).
Establishment—Unsuccessful, both deer were killed within 2 years (Reiher, pers. comm.).

**12. Motupiko, Nelson**

1903: Three young stags of Windsor strain from Wairarapa (Nelson Acclimatisation Society records; Wellington Acclimatisation Society records). There is disparity over the number of deer involved; the Wellington Acclimatisation Society reports dispatching two, whereas the Nelson Acclimatisation Society reports receiving three, but it is thought that the actual number liberated was three. Other than the Nelson Acclimatisation Society's stated intention to liberate these deer, and one other obtained locally, at Motupiko, there is no mention of the liberation. However, Mr J. A. Palmer (pers. comm.) recalls that the liberation occurred as intended.
Establishment—These deer would have integrated with the "Nelson herd" which were already numerous in the liberation area. A stag bearing an English deer-park eartag, shot by Mr D. W. Winn (pers. comm.) at Owen Junction in 1904, was presumably one of the liberated stags. Soon after 1904 occasional deer bearing Windsor characteristics were shot in the Mt Owen-Wangapeka area.

**13. Lower Buller region**

1905: One stag and five hinds, Windsor strain (Logan and Harris, 1967).
1905: One stag and five hinds, Windsor strain (Logan and Harris, op cit.).
1907: One stag (died) and one hind, Thorndon strain (Logan and Harris, op. cit.).
1907: One hind and fawn, strain unknown, possibly Thorndon (Logan and Harris, op. cit.; Buller Acclimatisation Society records).
1907: One yearling, sex unknown, Thorndon strain (Logan and Harris, op. cit.).
1908: One hind, Thorndon strain (Logan and Harris, op. cit.).
1909: Six, Windsor strain (Logan and Harris, op. cit.).
1913: Two stags and four hinds from Otago (Logan and Harris, op. cit.) presumably Invermark strain.
1913: Two stags and one female fawn (Logan and Harris, op. cit.).
1913: Two stags and one yearling (Logan and Harris, op. cit.).
1913: Two, sex and strain unknown (Logan and Harris, op. cit.).
1923: Two stags and one hind Warnham × Windsor strain from Paraparaumu Game Park (Logan and Harris, op. cit.).
Establishment—These liberations were made in various tributary streams of the Buller River, on north and south banks within 30 miles of Westport, and at points adjacent to the Westport-Charleston road. The Paparoa range, Mt Rochfort range, and lower Buller valley were colonised by deer from this herd. At about 1918 the Lower Buller, Nelson, and Crushington herds coalesced and deer of the various strains became intermixed throughout the Paparoa range and Lower Buller valley. Today, characteristics of body and antlers of deer from these areas suggest that the population is predominantly of Windsor and Thorndon strains.

**14. Bainham, Golden Bay**

1906: Five hinds and one stag (Thorndon strain) captured at Aniseed Valley and Dun Mountain, Nelson, liberated by Mr F. Walker on west bank of Aorere River (M. R. Walker, pers. comm.)
Establishment—Dispersed rapidly along the slopes of the Wakamarama range and later coalesced with the Nelson herd (Walker, pers. comm.).

**15. Manaroa, Marlborough Sounds**

1908: One male fawn and one female fawn, Thorndon strain, obtained in lower Wairau valley, liberated by a resident, Mr Masefield (J. Rodgers, pers. comm.).
Establishment—Did not breed (Rodgers, pers. comm.).

**16. Wai-iti Valley, Nelson**

1911: Two stags, Warnham strain (C. Morrison, pers. comm.). Three stags were imported (Donne, 1924), one died before liberation (Nelson Acclimatisation Society records).

Establishment—Both stags were shot, one soon after liberation, the other four years later six miles from liberation point (Morrison, pers. comm.).

**17. Malvern, Avon Valley, Marlborough**

1916: Two or three stags, Stoke Park strain, acquired from upper Rakaia, liberated by Mr D. Lester (F. Page; C. H. Rudd; W. A. Hood, pers. comm.).

Establishment—For several years after the liberation, hunting was not permitted in the upper Avon valley, thus allowing a period of undisturbed establishment. Soon after the liberation, deer from the "Nelson herd" occupied the Avon valley. Large beasts bearing antlers of up to 20 points, the progeny of the liberated stags, were subsequently shot in the Avon, Spray, and Waihopai valleys and these areas were considered to hold the best trophy animals in the Marlborough district (Marlborough Chamber of Commerce, 1929). In later years, similar beasts were also shot in the upper Awatere, Guide, and Dillon valleys. A distinctive feature of many of the antlers is a "throwback point", relatively common in the Stoke Park strain, which erupts from the anterior of the beam above the trez tine.

**18. Birch Hill, Wairau Valley**

1917: Two yearling males and one 2-year-old male, Otago-Scottish origin (Otago Acclimatisation Society records; G. Andrews, pers. comm.).

It appears that Logan and Harris (1967) have mistaken the liberation point to be Birch Hill, Waihopai Valley.

Establishment—Within days of liberation one of the yearling males was shot (Andrews, pers. comm.) and in 1920 another was shot on Mt Patriarch (P. Buschl, pers. comm.). In 1931, an old stag bearing a metal ear tag, thought to be the third beast, was killed in the Acheron River area (F. Page, pers. comm.). Occasional beasts bearing Scottish type antlers were shot in the Leatham River soon after the liberation, but were rarely sighted after Nelson deer became numerous in that area.

**19. Upper Waihopai Valley, Marlborough**

1919: One stag, obtained from Wellington (C. J. Haines, pers. comm.). Possibly Warnham strain from Paraparaumu Game Park.

Establishment—Occasionally, between 1920 and 1940, deer possessing Warnham type antler characteristics were obtained from the Waihopai River headwaters and Leatham River areas. These are thought to be the progeny of the liberated stag.

**20. Rainbow Valley, Upper Wairau River**

1920 (About): Two yearling males, captured at Glenhope, South Nelson (presumably Thorndon strain) (N. McConachie, pers. comm.).

**21. Fern Flat, Murchison**

1922: One stag, Warnham strain, imported by Nelson Acclimatisation Society, liberated by Mr N. McConachie (McConachie, pers. comm.).

Establishment—This stag was shot 8-10 years later on Mt Hope, 30 miles north-east of liberation point (McConachie, pers. comm.).

## APPENDIX 2

### Sources of Data in Figs. 3-7

**Personal Communications:**

Messrs R. Archer, Tuna Bay, Havelock; E. H. Austin, Blenheim; L. G. Austin, Nelson; "Mick" Banks, Reefton; T. A. Barrett, Lewis Pass; A. G. Beardmore, Collingwood; W. Blackadder, Rahu; N. L. Bolitho, Reefton; W. J. Borlase, Richmond; L. Boyd, Oxford;

A. Brereton, Motueka; E. C. Brown, Kaikoura; G. H. Burroughs, Wakatu, Nelson; J. Burroughs, Ahaura; "Paddy" Buschl, Blenheim; W. J. Cairns, Punakaiki; C. Carlson, Kikiwa, Nelson; W. Clark, Blackball; P. Coates, Kopara; W. Couper, Blenheim; G. A. Douglas, Wakefield; T. R. Elkington, D'Urville Island; S. A. Esler, Marybank, Nelson; G. Everett, Atawhai, Nelson; J. R. Eyles, Richmond; B. A. Ferguson, Collingwood; W. Fischer, Punakaiki; C. A. Flowers, Lake Rotoroa, Murchison; H. W. Flower, Whangamoa, Rai Valley; G. Forbes, Waiau; J. Fowler, Wairau Valley, Blenheim; C. Gibbs, Brightwater, Nelson; N. Gibbs, Wakefield; G. Gilbanks, Kongahu; Westport; A. S. Giles, Edgecombe, Clarence Bridge; F. Glover, Blenheim; H. M. Good, Kekerengu; R. Griffith, Taihape; G. Hahn, Ahaura; (**also** his mother, Mrs G. A. Hahn, Ahaura); T. Hahn, Ahaura; C. J. Haines, Renwicktown; J. Hall, Blenheim; C. N. Harvey, Picton; I. J. Hebberd, Tophouse; J. Henderson, Kenepuru Sound; T. R. Henshaw, Kia-ora Downs, Culverden; G. Hille, Waihopai Downs, Blenheim; W. Holmwood, Tahananui, Nelson; W. A. Hood, Blenheim; E. S. Hope, Deep Bay, French Pass; T. R. Hutchinson, Havelock; M. C. Hyde, Gore Bay, Cheviot; J. T. Jackson, Blenheim; T. G. Jones, Kaikoura; J. Keller, Rai Valley; J. Kilkenny, Westport; W. Landon-Lane, Hillersden, Blenheim; H. S. Langridge, Barrytown; (Mrs) M. E. Leaman, Parnassus; H. Leov, Port Ligar, Rai Valley; G. Lott, Wairau Valley, Blenheim; A. S. Lyford, Blenheim; G. McClean, Okaramio, Blenheim; A. H. McConachie, St. Arnaud, Nelson; N. McConachie, Tui Glen, Nelson; J. J. McFarlane, Blenheim; L. R. C. Macfarlane, Culverden; D. A. McMoreland, Nelson; H. T. McNabb, Karamea; P. E. Mills, Havelock; B. Murfin, Oulton, Ikamatua; C. Morrison, Brightwater; G. H. Mullholland, Seddonville; S. H. Mytton, Woodstock, Motueka; L. Neilson, Blackball; A. L. Nicholls, Stoke, Nelson; V. Nicholls, Korere Valley, Nelson; E. V. Noble, Rapohoe; A. R. B. Norriss, Rappahannock Valley, Murchison; D. W. Oxnam, Murchison; E. Page, Collingwood; F. Page, Blenheim; J. A. Palmer, Korere Valley, Nelson; L. E. Powell, Charleston; P. E. Powell, Grovetown, Blenheim; A. Price, Motueka; F. A. K. Price, Richmond; E. A. Reiher, Kaikoura; J. Richards, Collingwood; C. A. Robertson, Takaka; J. Rodgers, Havelock; W. J. Rowe, Barrytown; C. H. Rudd, Picton; D. A. Rutherford, Leslie Hills, Culverden; W. Scarlett, Karamea; C. F. Schwass, Blenheim; C. Sharland, Pelorus Bridge, Rai Valley; J. Shaw, Roa; G. Sheard, Ranunga; C. F. Shuttleworth, Wakefield; C. A. Silcock, Thorpe, Motueka; T. A. Slape, Havelock; J. T. Solomon, Blenheim; W. C. R. Sowman, Richmond; L. Stratford, McLarens Bay, Rai Valley; D. J. Stringer, Wakefield; G. Terrell, Blenheim; R. Thomas, Motueka; D. A. Thompson, Waiau; J. W. Thomson, Burnbrae, Murchison; J. E. Tomlinson, Stoke, Nelson; C. Upham, V.C., Parnassus; M. R. Walker, Bainham; R. Wells, D'Urville Island; T. W. Wells, Todds Valley, Nelson; C. Wilkinson, Takaka Valley; A. Williamson, Gore Bay, Cheviot; D. W. Winn, Stoke, Nelson; W. Woodcock, Murchison; B. W. Woodman, D'Urville Island; and Mrs T. Young, Blenheim.

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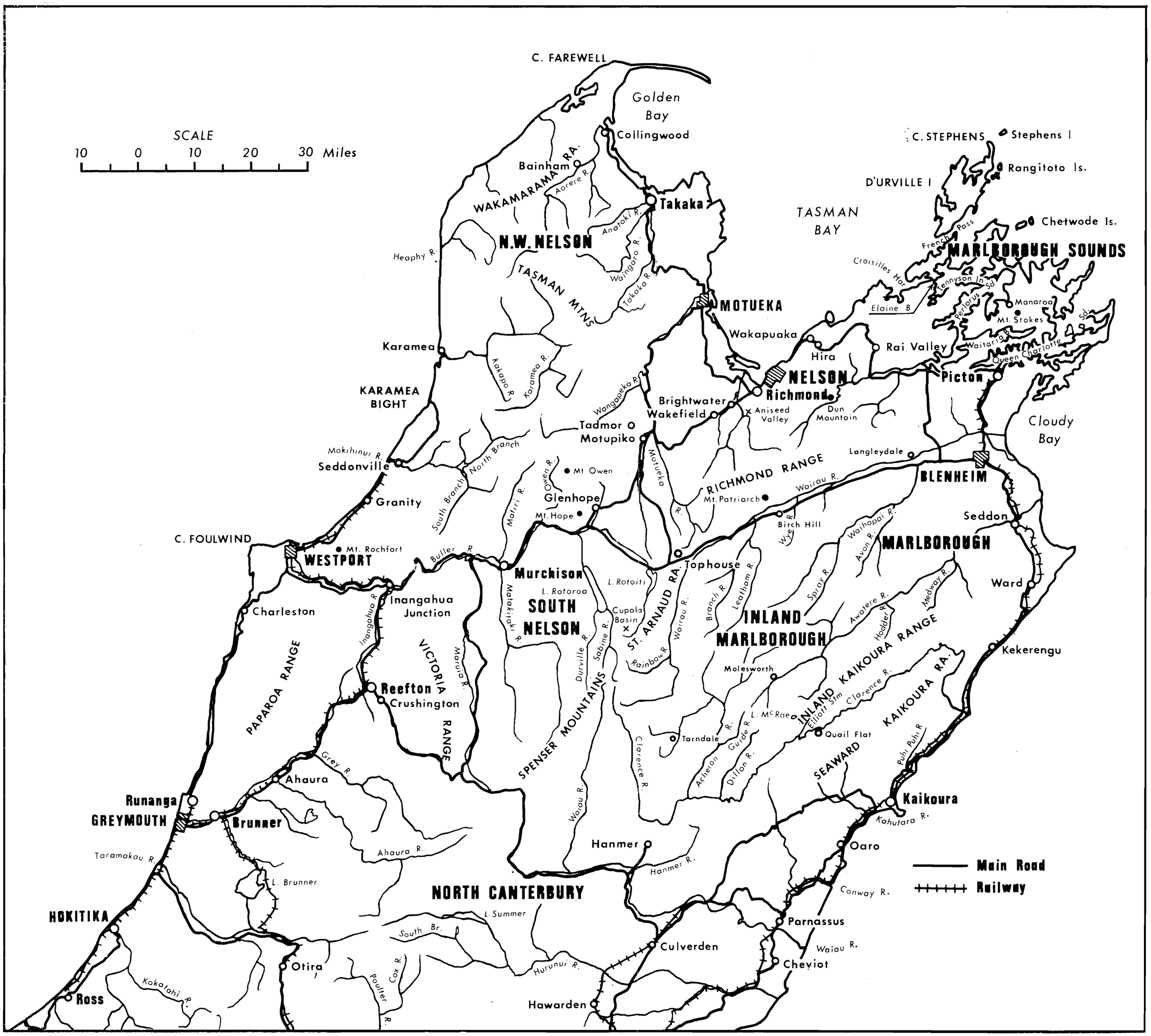


FIG. 1—The study region showing place names and areas mentioned in the text.

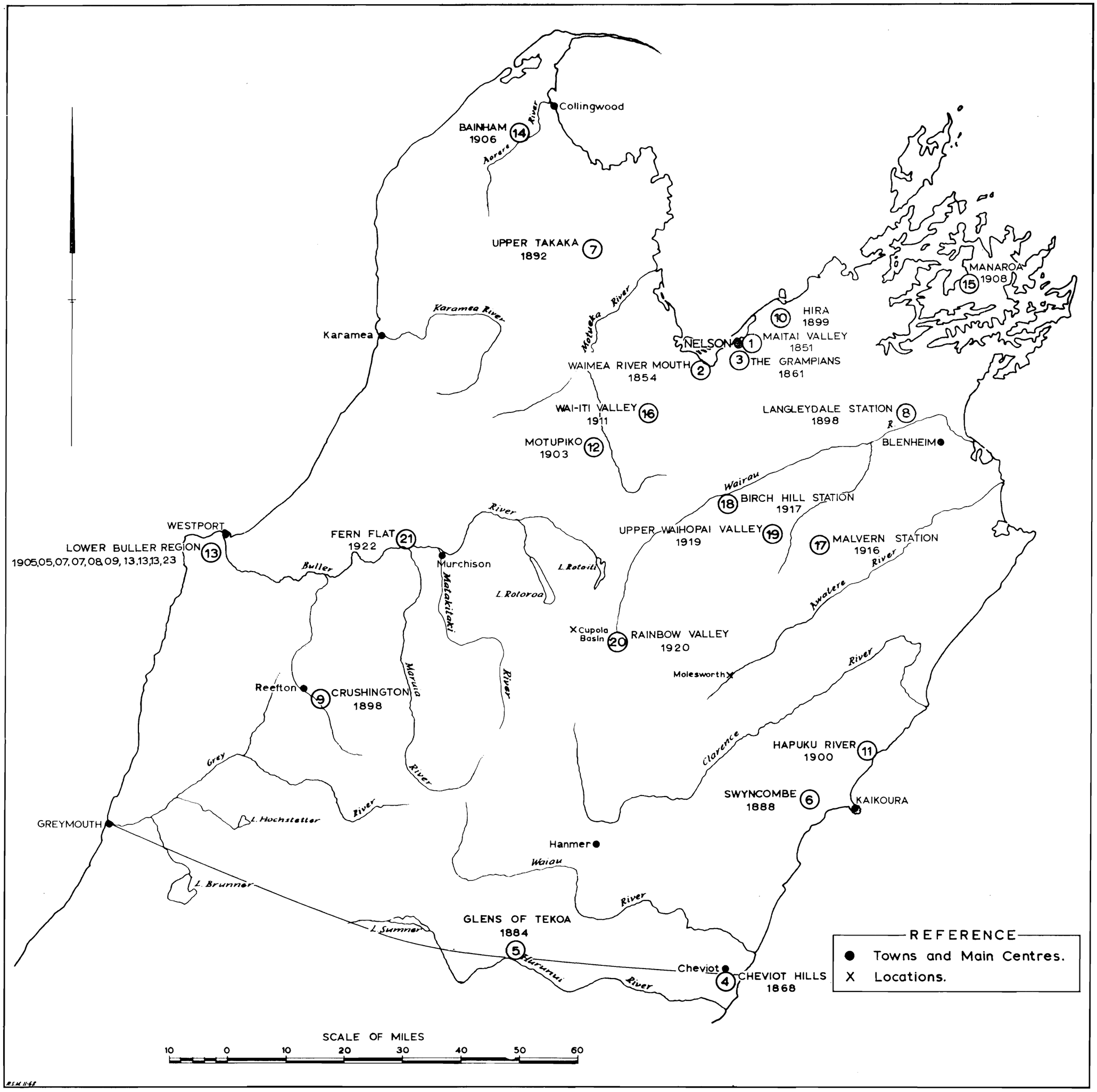


FIG. 2—Dates and locations of red deer liberations in northern South Island districts. Encircled numbers designate liberations in chronological order of release and provide reference to details of liberation and establishment listed in Appendix 1.

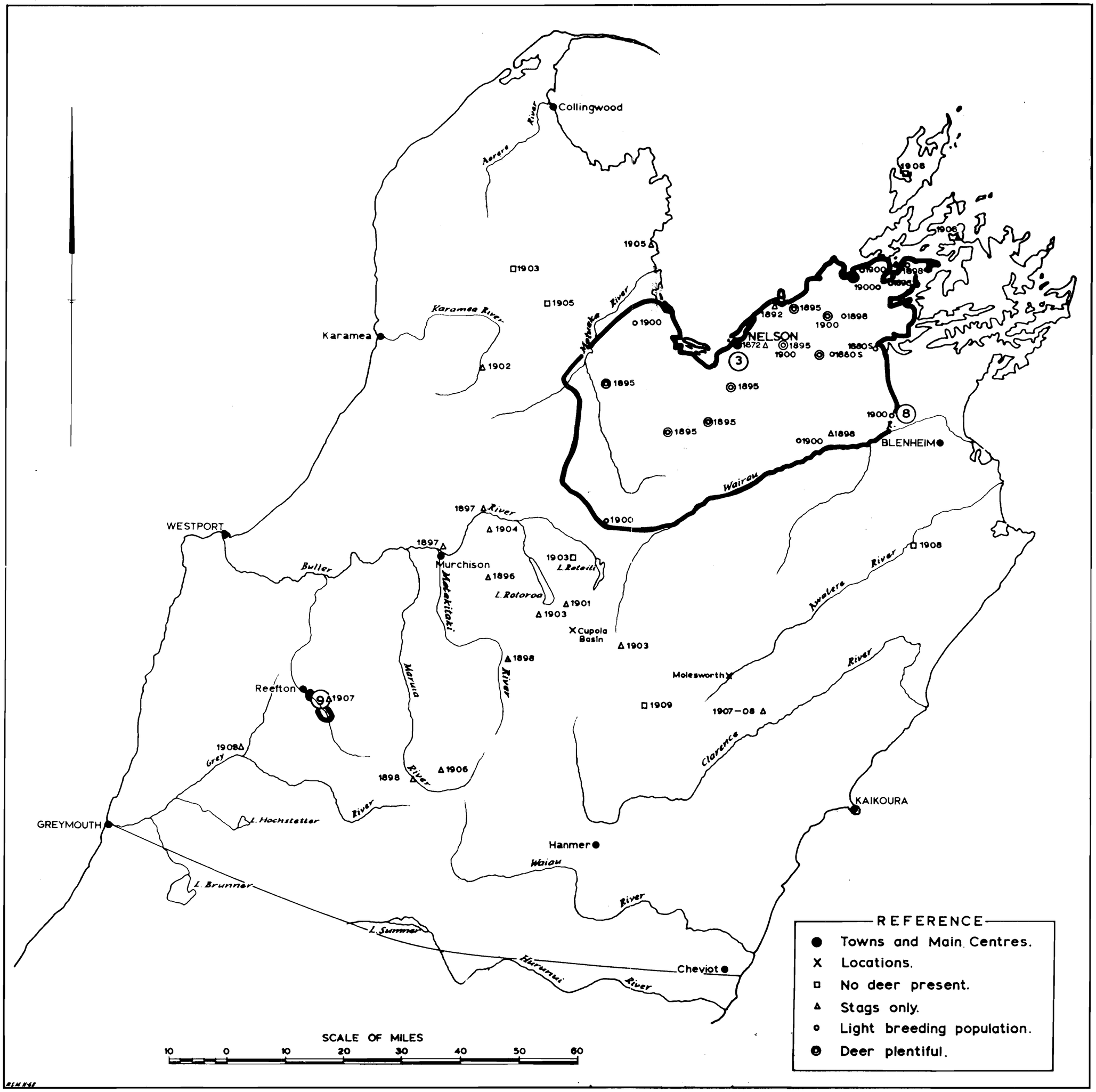


FIG. 3—Distribution of breeding populations of red deer in northern South Island districts at 1900. Records to 1910, showing deer absent or only stags present appear outside the range of breeding populations. Successful liberations up to 1900 are designated by encircled numbers (**see** Appendix 1). (The two records of stags sighted in the Maruia valley in 1898 and near Reefton in 1907 are not to be confused with dispersal from the nearby Crushington liberation, as it is known that both stags were from the Nelson herd).

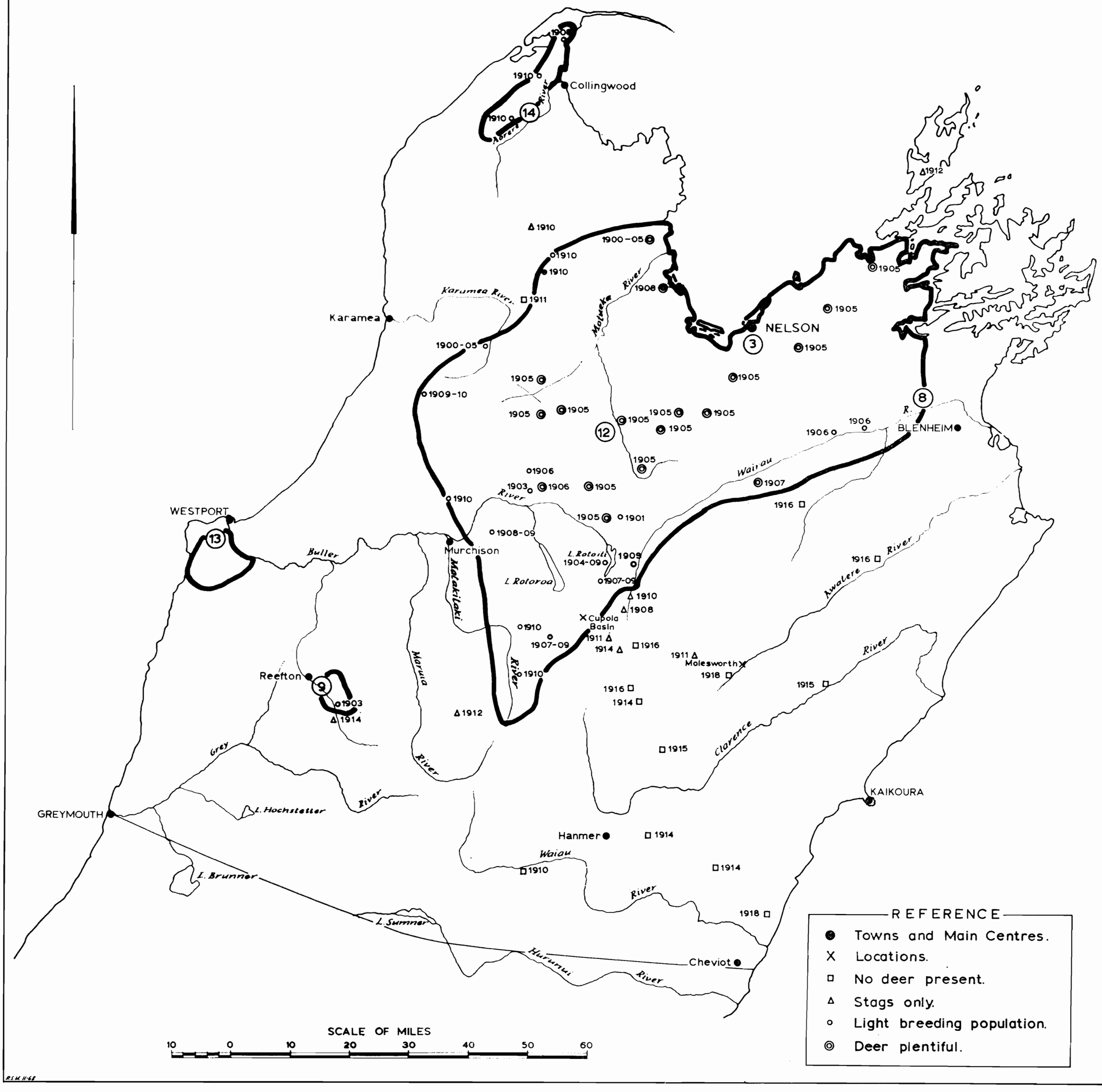


FIG. 4—Distribution of breeding populations of red deer in northern South Island districts at 1910. Records to 1920, showing deer absent or only stags present appear outside the range of breeding populations. Successful liberations up to 1910 are designated by encircled numbers (**see** Appendix 1).

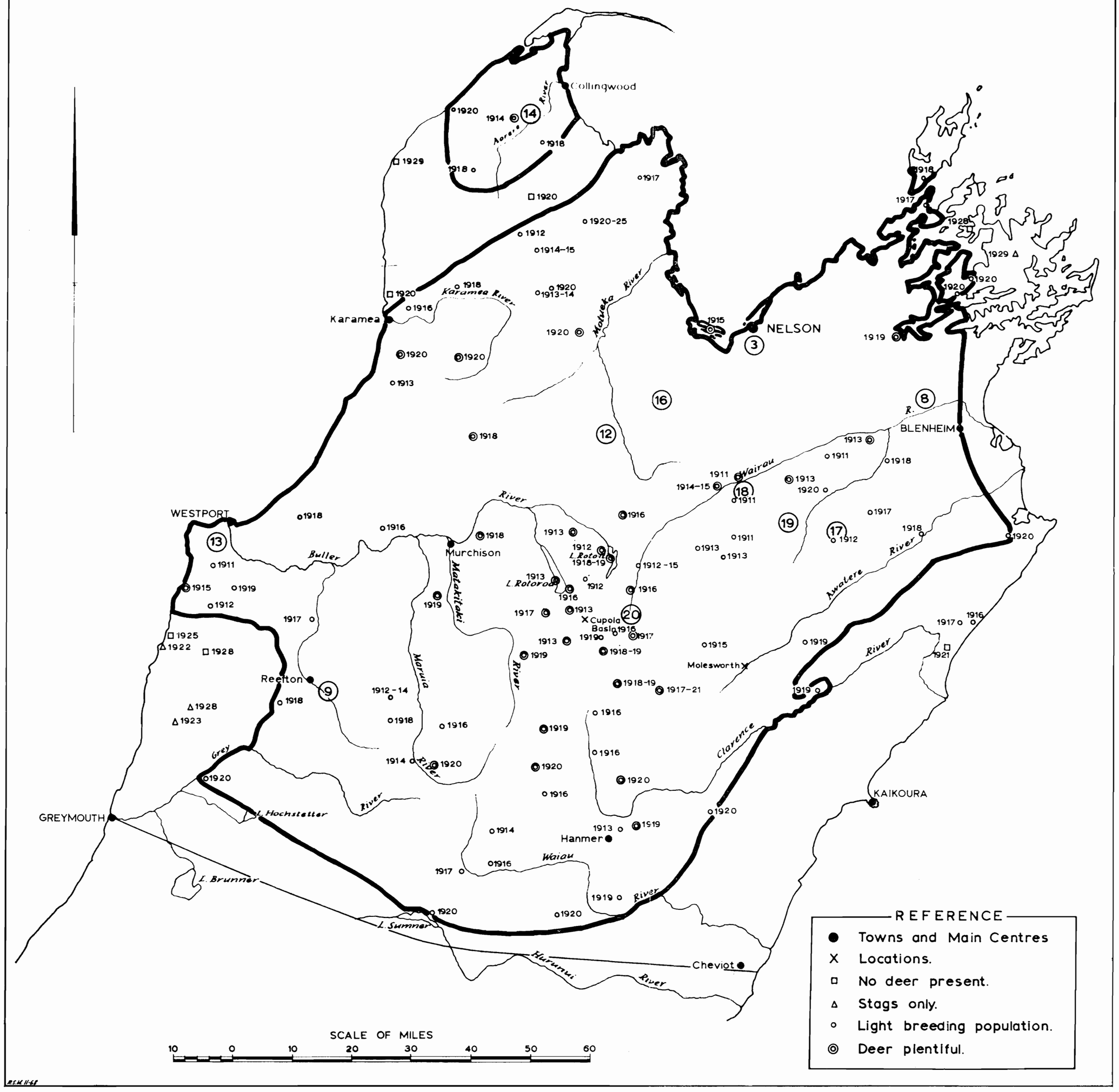


FIG. 5—Distribution of breeding populations of red deer in northern South Island districts at 1920. Records to 1930, showing deer absent or only stags present appear outside the range of breeding populations. Successful liberations up to 1920 are designated by encircled numbers (**see** Appendix 1). (The two records of light breeding population at 1916 and 1917 near the coast north of Kaikoura are those of a single hind which had strayed well beyond the normal distribution of the breeding population.)

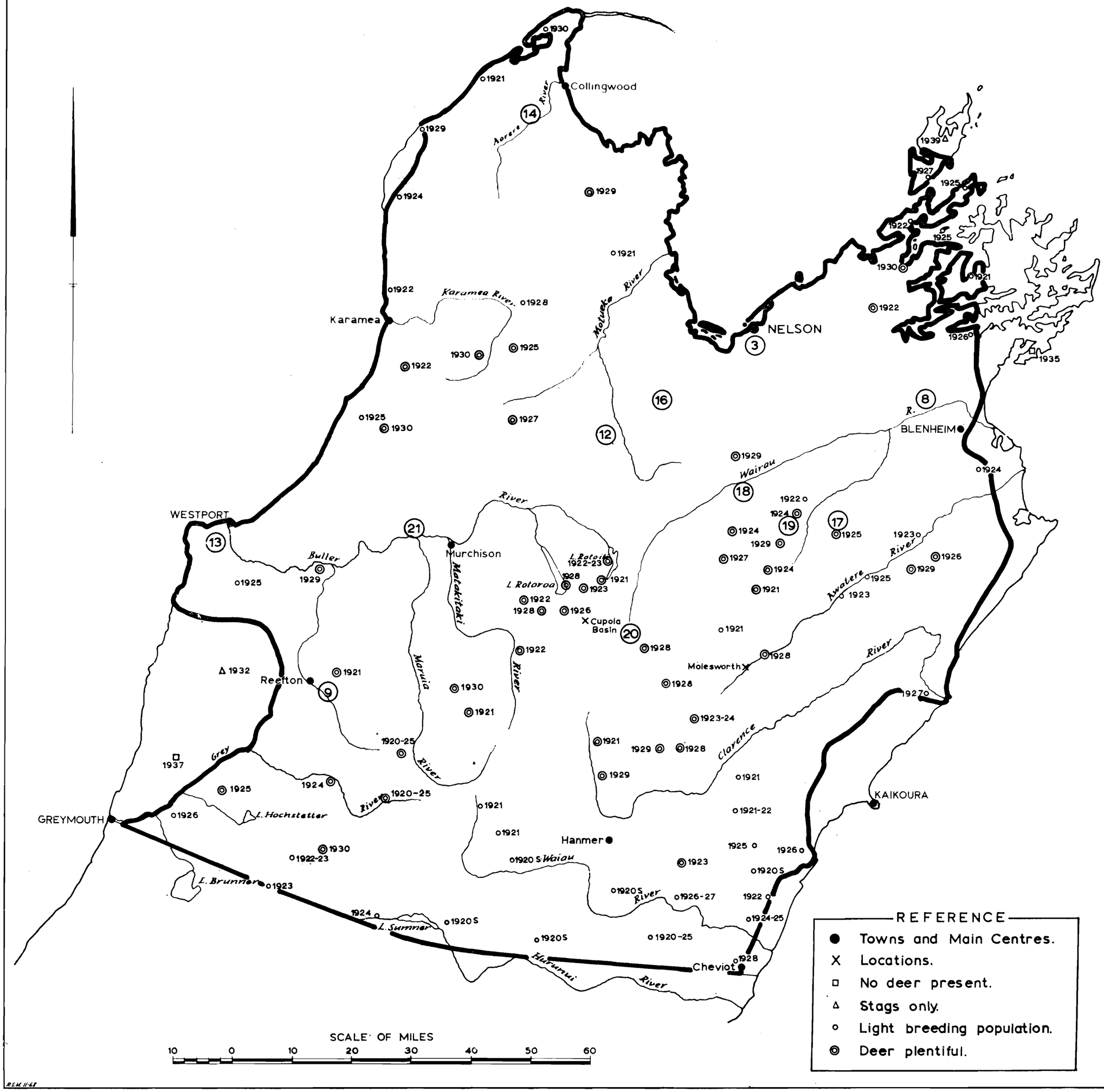


FIG. 6—Distribution of breeding population of red deer in northern South Island districts at 1930. Records to 1940, showing deer absent or only stags present appear outside the range of the breeding population. Successful liberations up to 1930 are designated by encircled numbers (**see** Appendix 1).

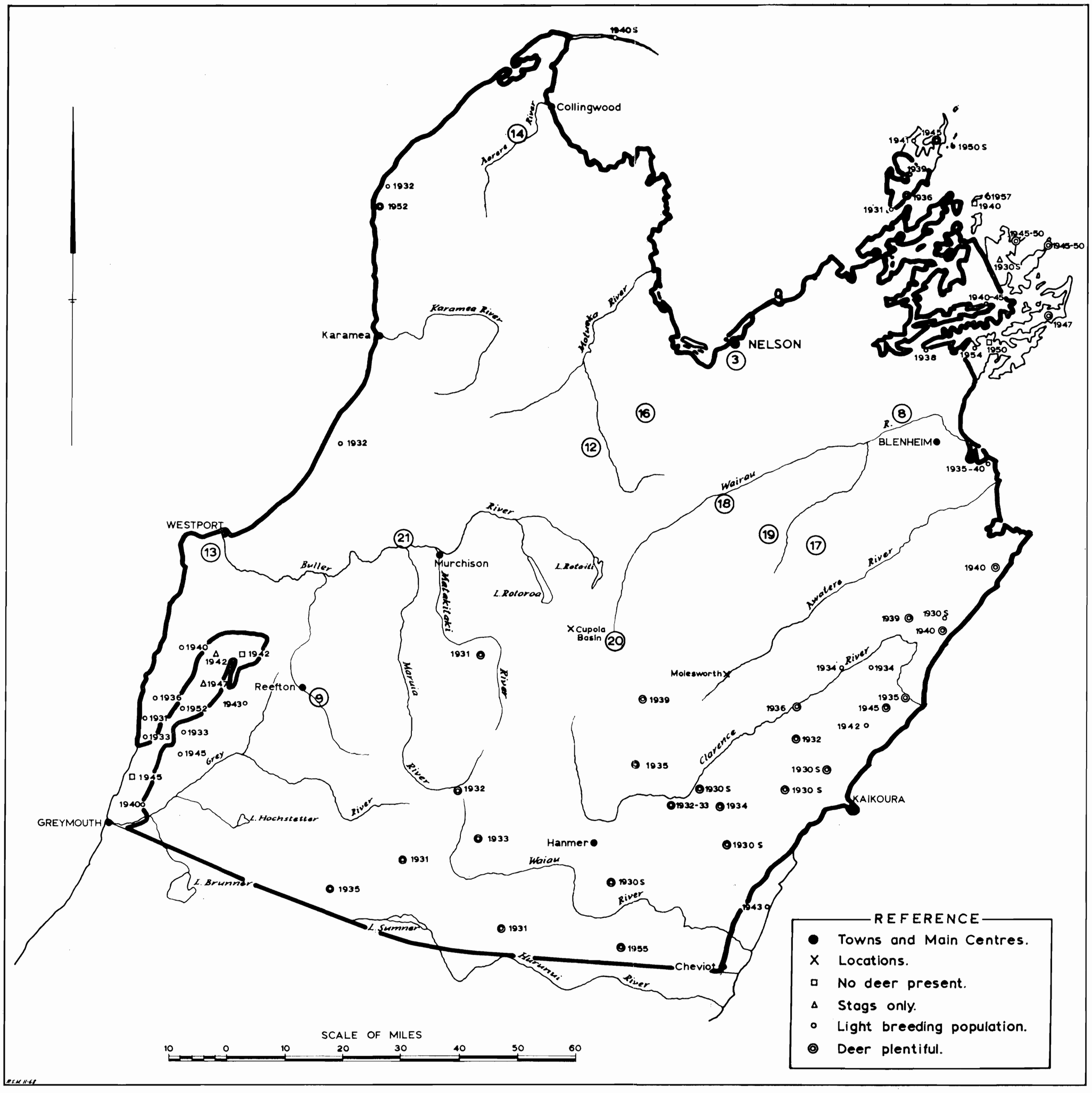


FIG. 7—Distribution of breeding population of red deer in northern South Island districts at 1940 and dates of occupation and population build-up in areas colonised after 1940. Records to 1950, showing deer absent or only stags present appear outside the range of the breeding population. All successful liberations are shown by encircled numbers. (The record of deer becoming plentiful in the Lowry Peaks range south of Hanmer in 1955 is believed to be a temporary occurrence due to an exodus of deer from the Balmoral State Forest during fire.)

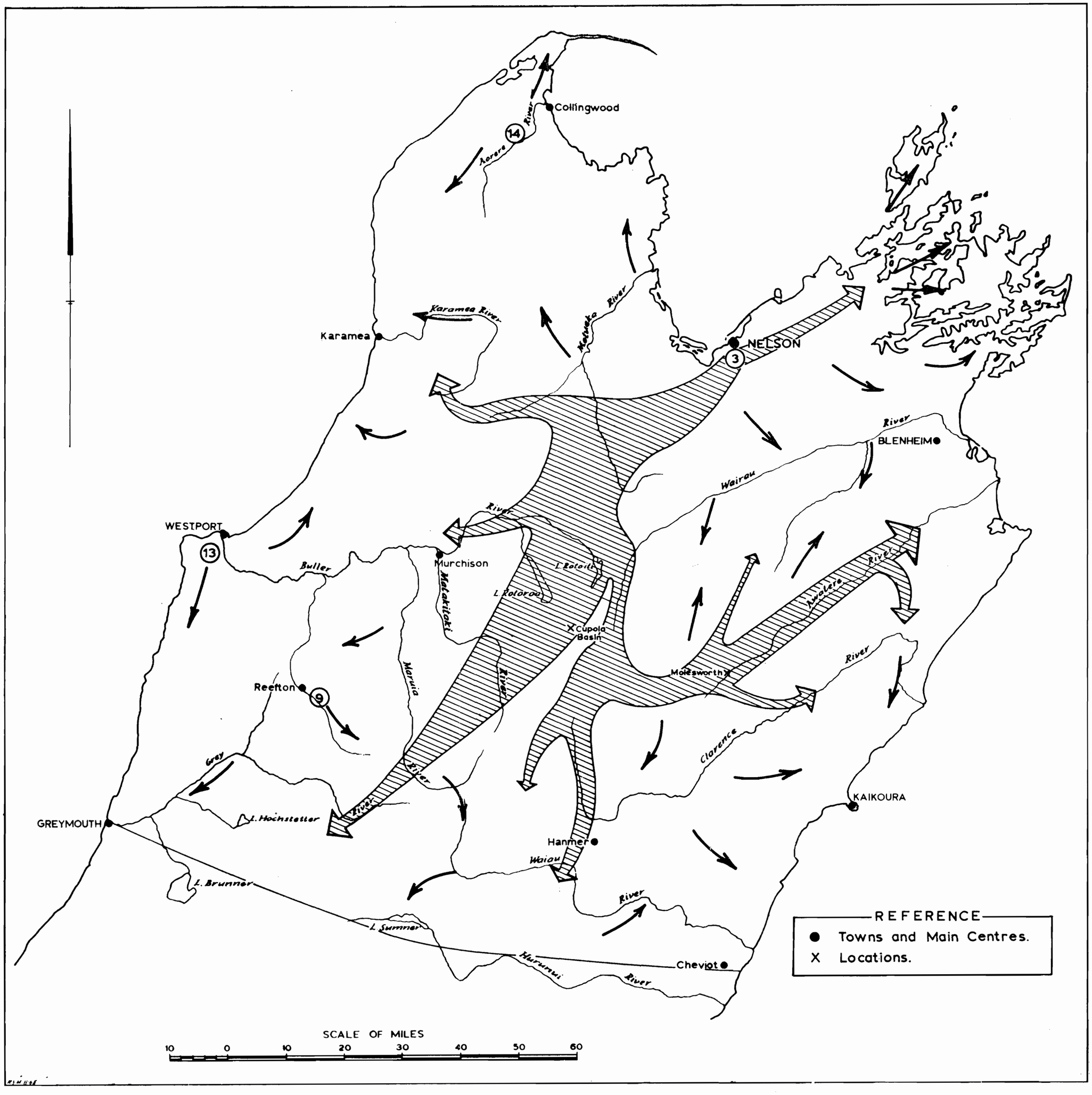


FIG. 8—Routes and directions of dispersal of red deer in the northern South Island districts. Major dispersal routes are shown by the hatched region, subsidiary movements are indicated by arrows. The liberation points from which dispersal occurred are shown by encircled numbers (**see** Appendix 1).