Survey of the status and distribution of the wildcat in Scotland, 1983 - 1987

Nature Conservancy Council *for* Scotland

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N Easterbee, L V Hepburn and D J Jefferies

Dr Nigel Easterbee was tragically killed in a road accident on 11 December 1990 before he could see the completion of this survey in print.

I first suggested that Nigel take up the problem of the wildcat, its survey and conservation as a special study in 1981. From that date his cheerful enthusiasm, energy and dedication in this field have been both remarkable and valuable. In the intervening years we have achieved legal protection for the species in 1988, a thorough survey of its status and distribution, and studies of its hybridisation with feral cats and recently of its field behaviour and habitat requirements with the use of radiotracking. Much of this has been due to Nigel's efforts. I hope that the present survey report and analysis of past records will serve as a fitting tribute to him and be of practical value to wildlife conservationists for many years to come. This is what he would have wished. Nigel will be sadly missed by his many friends and colleagues. It was indeed a pleasure and a privilege to work alongside him.

Don Jefferies
Vertebrate and Terrestrial Pollution
Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough
PE1 1JY

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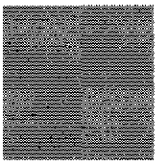

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Summary

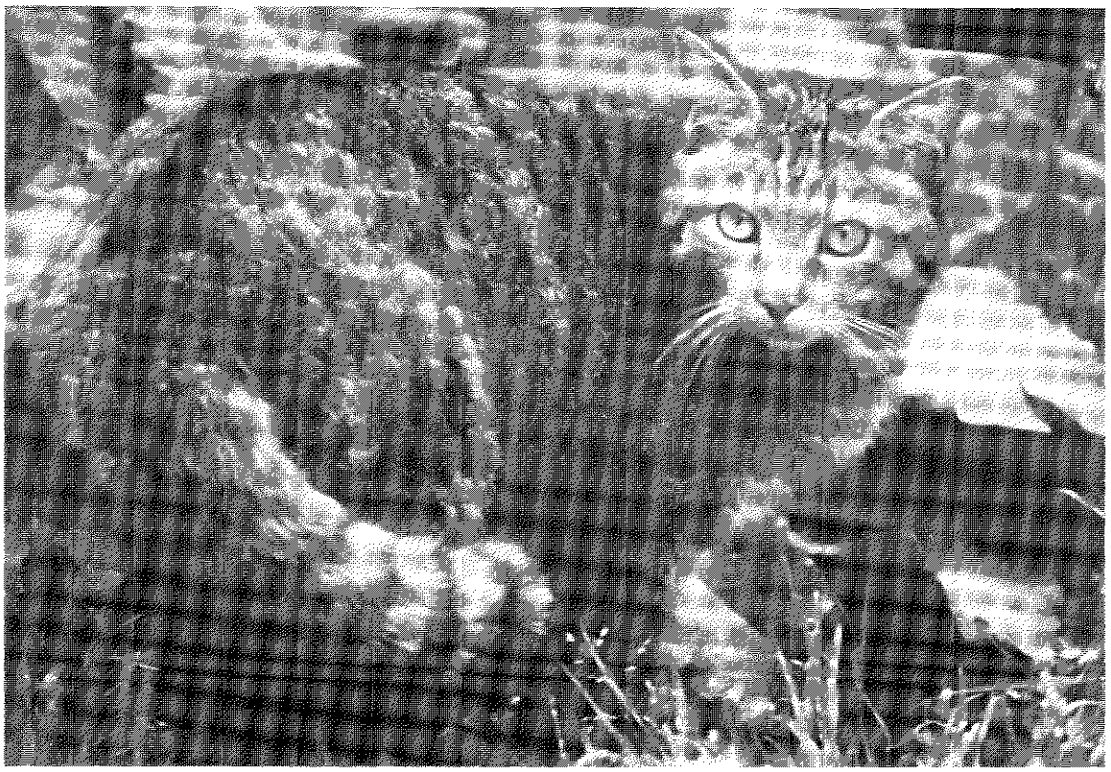
In order to implement appropriate policies for the conservation of a species such as the wild cat it is necessary to understand its ecological requirements and to have sufficient knowledge of its status and distribution. Between 1983 and 1987 the Nature Conservancy Council, as part of a programme of work on the rarer British carnivores, undertook a systematic survey of the wildcat population in Scotland. Records of the distribution and status of wildcats were collected from 499 ten km squares in Scotland, with more than 400 people supplying information. No evidence of wildcats was found south of a line between Edinburgh and Glasgow. North of the Central Lowlands, the main populations of wildcats were found to occur in north-east Scotland, Easter Ross, north-east Inverness-shire, Strathspey, east Perthshire and parts of Argyll. Elsewhere, particularly in the mountainous areas of the west and north, wildcat occurrence was found to be sporadic. The density of wildcat populations was generally low, even in areas of suitable habitat, the population in north-west and west Scotland being particularly sparse. Over 30% of populations were reported to have declined in recent years, compared with only 8% reported as increasing. Persecution was found to have been widespread, and was considered to be a significant threat to small, isolated wildcat populations. Hybridisation with feral domestic cats has been identified as a major long-term threat to the species. The purer wildcat populations are likely to be those occurring in the more remote areas of the north and west. These populations are considered to be vulnerable to persecution and other factors and are reported to be decreasing.

This survey has established a baseline of distribution and status of the wildcat in Britain in 1983 - 1987, against which future changes in status can be compared.

1 Introduction

The British mammals have not had the long history of survey of some of the birds such as the great crested grebe *Podiceps cristatus* or heron *Ardea cinerea*. The conservation of many mammals, however, is an important and controversial issue and it is imperative to know whether their populations are increasing or decreasing. It is often possible to deduce the causes and timing of changes in a population from precise records collected over a known period. With a knowledge of the causes we are better equipped to conserve these populations.

Precise information about the size of the population and its distribution is still not available for many British mammals. We have, therefore, no baseline against which to gauge future changes. Over the past decade the Nature Conservancy Council (NCC) and the Vincent Wildlife Trust (VWT) have been collecting information on several mammals of conservation importance, particularly the carnivores. Surveys of the otter *Lutra lutra*, badger *Meles meles* and the pine marten *Martes martes* have been completed; the present survey of the wildcat *Felis silvestris* continues this work.



Scottish wildcat

(Photo by courtesy of Sandi Hubbard)

The wildcat

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2.1 The wildcat is the only native member of the Felidae living in Britain. In the British Isles it is now found only in Scotland. It is superficially similiar to the domestic 'tabby' cat *Felis catus*, but the coat pattern and tail are different and wildcats are typically larger and more robust; males weigh on average 5 kg and females 4 kg.

2.2 The wildcat is found in Scotland (at the northern extremity of its range), through central southern and south-east Europe to the Middle East and the Caucasus. It also occurs throughout Africa, except in equatorial forests and deserts, and into Asia as far east as north-west China and Mongolia. A gradual transition of coat colour occurs, from the greyish European form to the paler sandy-coloured forms of the Asiatic steppes and North Africa.

2.3 T[redacted] wildcat was distinguished as a separate subspecies, *F. silvestris grampia* (Miller 1912), apparently differing from *F. silvestris silvestris* of central Europe in its overall darker colour and more distinct black stripes. However, as noted by Kolb (1977), these characteristics are variable in both the continental European and Scottish populations, and ~~there is, therefore~~, little justification for assigning British wildcats to a separate subspecies.

2.4 Originally wildcats appear to have occurred in a variety of habitats throughout Europe. They probably used deciduous and coniferous woodland for shelter, particularly in winter, and hunted over more open areas such as forest edge, open woodland, thickets, scrub, grassy areas and marsh. The wildcat was probably driven into more mountainous habitats by deforestation and persecution.

2.5 Wildcats are territorial and, except at mating, solitary (Corbett 1979). Male and female ranges in north-east Scotland are similiar in size (mean annual area of 175 ha) (Corbett 1979). However, range size will vary in relation to habitat quality, and in less favourable habitats than Corbett's study area much larger ranges can be expected. Considerable variation in range size has been recorded in continental Europe, with estimates from 60 ha to 1,000 ha (Schauenberg 1981).

3 Historical background

3.1 The wildcat returned to Britain in post-glacial times and was once found throughout the country; its remains were found at the Mesolithic camp at Thatcham, Berkshire (10,050 - 9,600 B.P.) (King 1962). There is no evidence that the wildcat occurred on the larger offshore islands. It may have occurred in Ireland (Wijngaarden-Bakker 1974), but if so it died out relatively early. The wildcat progressively declined in Britain because of the combined effects of habitat destruction and persecution.

3.2 The decline of the wildcat in Britain during the nineteenth century has been comprehensively documented by Langley & Yalden (1977). Information prior to 1800 is sparse, but the historical material these authors consulted indicates that wildcats probably died out as early as the sixteenth century in the south of England, although they may have persisted longer in the south-west. By 1800 the wildcat was absent from England to the south of Yorkshire and Lancashire, and also from the lowland counties of Scotland. During the nineteenth century the decline of the wildcat accelerated; Harvie-Brown (1882) was unable to assign dates to the disappearance of the wildcat from Lanarkshire, Ayrshire and Renfrewshire, because it had by then been extinct in these areas for such a long time. However, Langley & Yalden (1977) suggest it could have disappeared from Ayrshire, Dumfries-shire, Kirkcudbright and Wigtown by 1830. The last documented record for the Border counties of Scotland is 1849 for Berwickshire (Hardy 1857), although a specimen on display at Mellerstain Castle near Kelso could be later; its date of capture is unknown. Extinctions followed rapidly after 1850, and the wildcat disappeared completely from England after its loss from Northumberland in 1853, and also from Wales by 1870 (Langley & Yalden 1977). Dates of loss in Scotland are approximately as follows: Dumbartonshire 1857 (Harvie-Brown 1882), Angus about 1872, Kincardineshire 1880 and Aberdeenshire 1875 (Harvie-Brown 1882), Stirlingshire by 1880 (Rintoul & Baxter 1935), Morayshire 1882 (Harvie-Brown & Buckley 1895) and Perthshire 1899 (Harvie-Brown 1906). During this period the range of the wildcat in Scotland was steadily contracting towards the remoter areas of the north and west. The population reached its nadir around 1914/15, when wildcats were confined to north Argyll, western Inverness-shire, Wester Ross, west Sutherland and west Caithness (see Figure 3.1). Evidence presented by Langley & Yalden (1977) indicates that persecution was the primary cause for this dramatic decline from 1800 onwards. Reduction in persecution correlates with population spread, thus supporting this statement.

3.3 Reafforestation commenced in Scotland between 1750 and 1850, and Anderson (1967) refers to the extraordinary planting activity of Scottish landowners in the century from 1750 to 1850, when over 202,000 ha (500,000 acres) of land were planted. Although this level of momentum was not maintained from 1850 to 1914 and there were even reports of felling exceeding plantings in some areas, nonetheless the area of plantation forest increased; the advent of war in 1914 and the necessity for a strategic reserve of timber prompted the establishment of the Forestry Commission in 1919. Thus during the time when the range of the wildcat was diminishing most rapidly, reafforestation was well underway and the area of Scotland under trees was increasing.

3.4 It was during the nineteenth century that the gamekeeping profession rose to prominence in Scotland, with the establishment of many sporting estates. Attitudes towards the wildcat, and to other species classed as vermin at that time, can be judged from accounts by St John (1893) and by Mackenzie (1921), who admits to the wish to exterminate both wildcats and foxes *Vulpes vulpes*. Ritchie (1920) considered that "the rapidity of the extermination of the wildcat during a comparatively short space of years in country highly adapted for its preservation

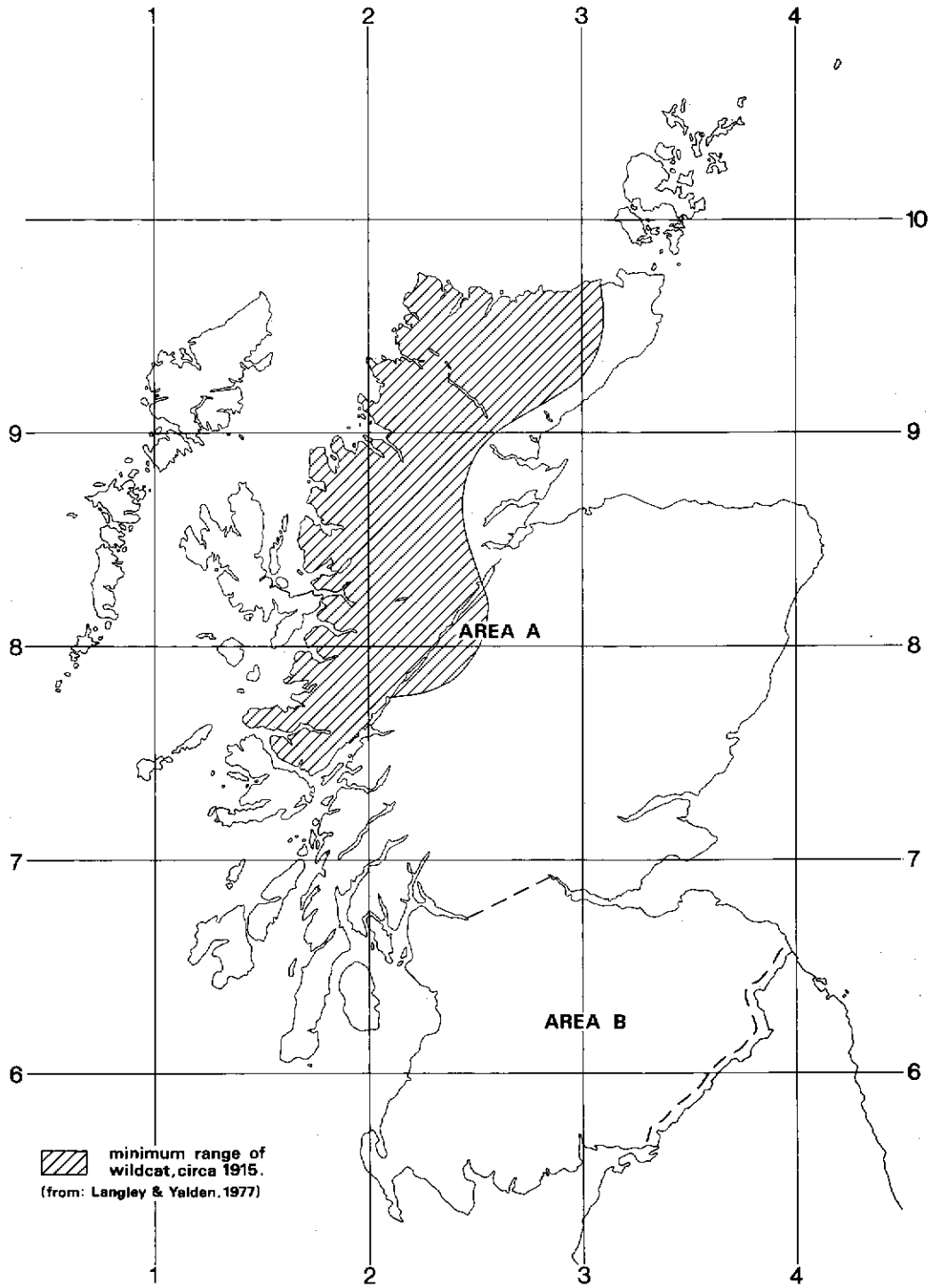

Figure 3.1

The probable minimum population range of the wildcat around 1915 - the 'relict' area (Langley & Yalden 1977). Area A is the main survey area and area B is south Scotland, as referred to in Section 5.

is a matter for wonder". He presents figures indicating the scale of persecution; for example, between 1831 and 1834, 901 wildcats, pine martens and polecats *Mustela putorius* were alleged to have been killed on the Duchess of Sutherland's estates in Sutherland. Nethersole-Thomson (1951) gives figures for the persecution which took place in Glengarry, where 198 wildcats were killed in three years, and in Glen Quoich, where 207 wildcats were killed over 19 years. Although such figures are now thought to have been considerably exaggerated to impress the estate owners and it seems inconceivable that wildcats could live at densities high enough to produce such figures, there was a substantial reduction in numbers. Langley & Yalden (1977) point out that the decline in carnivores during this period matches well the increase in gamekeeping; gamekeeping was also considered by Moore (1957) to be the cause of the decline of the buzzard *Buteo buteo* during the same period.

3.5 The recruitment of men for the armed forces in the First World War marked the turning point in the wildcat's fortunes. From 1914 to 1918 there was a period with very little persecution, since gamekeepers, in common with others, went off to fight. They never regained their pre-1914 numbers owing to changed economic conditions. The number of gamekeepers in Britain had decreased from *c.* 22,000 in 1914 to *c.* 5,000 by 1939 (Potts 1980). The wildcat seems to have responded rapidly to the reduction in persecution, and records show an increase in range, e.g. to north Perthshire in 1919 (Dent 1935); this information is summarised in Figure 3.2. However, Dent (1935) also mentions local declines in status in south Inverness-shire and north-west Perthshire. Further information on the spread of the wildcat between the two World Wars can be extracted from records presented by Kirk & Wagstaffe (1943). These authors obtained wildcats from a wide area of north Scotland, probably as a result of a general appeal for specimens, and the sources of their specimens probably reflected the density of wildcats in particular areas. They received five animals in 1919, from Ross-shire, Inverness-shire and Argyllshire; all of these specimens originated from the relict area of range (see Figure 3.1). The majority of their specimens(95%, n = 107), however, were collected between 1930 and 1939, and Figure 3.3 shows that although most specimens still originated from Ross-shire and Inverness-shire, there were signs of a modest expansion of range. Recolonisation of ground up to 1940 appears, therefore, to have taken place relatively slowly. There is some evidence that persecution resumed after the 1914 - 1918 war, and Batten (1953) reported that the stock of wildcats on high ground was greater in 1918 than in the early part of the 1950s, through the renewed efforts of keepers.

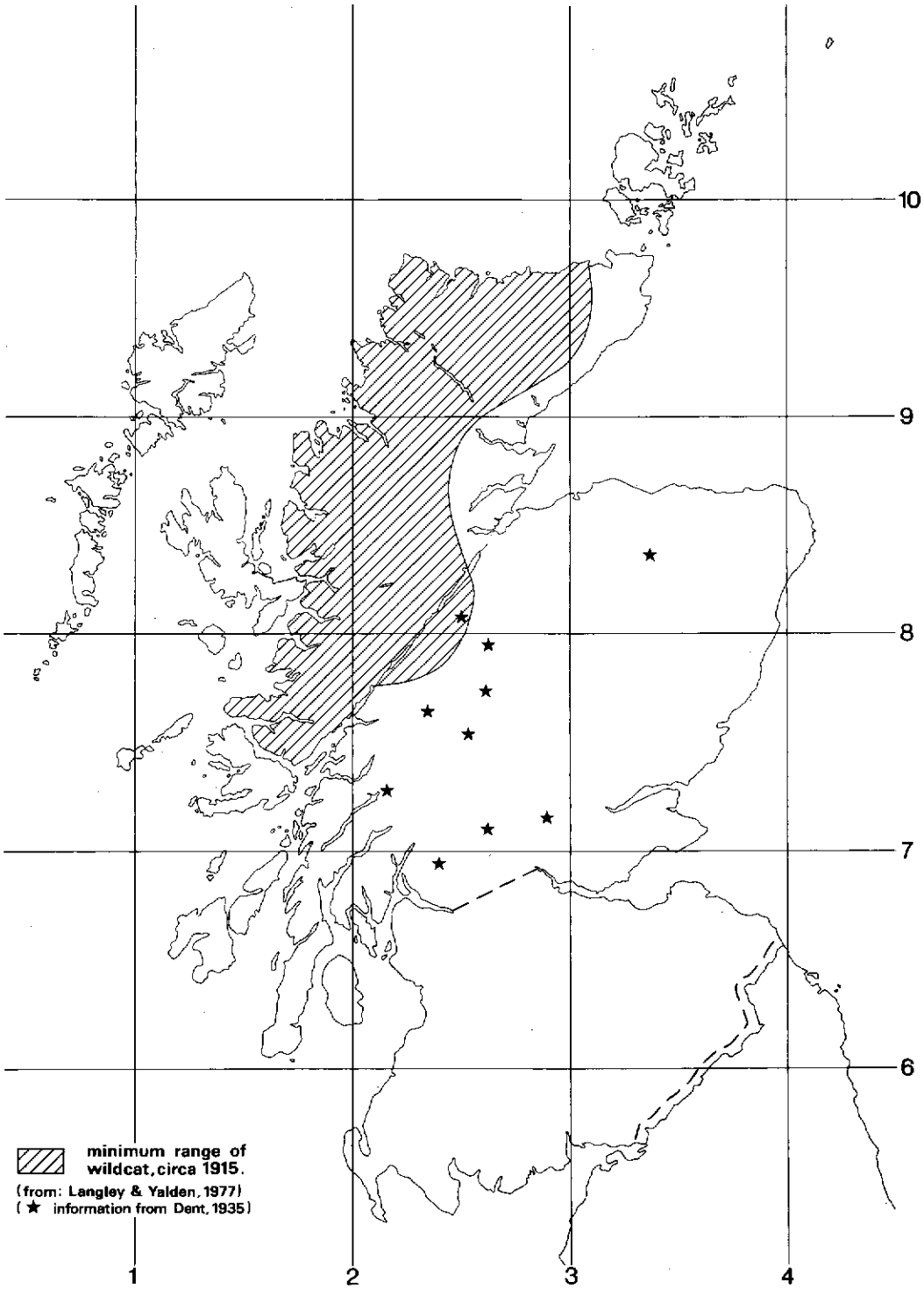

Figure 3.2

Records of wildcats during the period 1919 to 1935, from Dent (1935). The 'relict' area (1915) is shown by the diagonal hatching (From Langley & Yalden 1977)

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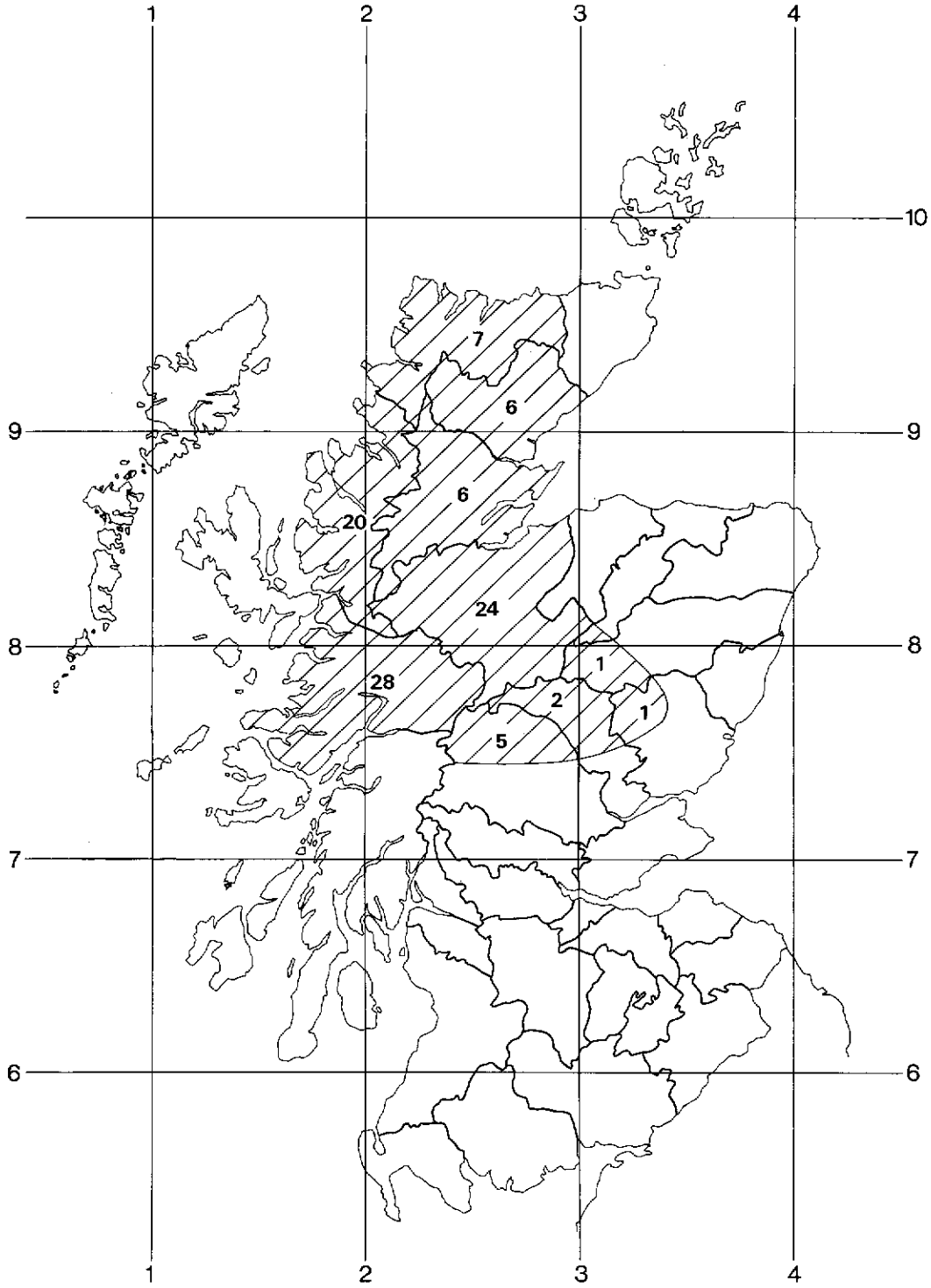

Figure 3.3

Percentage of specimens (by vice-county) received by Kirk & Wagstaffe (1943) between 1919 and 1939 (95% between 1930 and 1939)

Previous surveys of the wildcat in Britain

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4.1 The first survey of the wildcat was carried out by Taylor (1946), who recorded the presence of wildcats on Forestry Commission property in Scotland. His results are summarised in Figure 4.1. A further wide-ranging survey was carried out by Jenkins (1962) who established, by means of questionnaires, that wildcats had apparently increased their range. Hewson (1967) provides further information for Banffshire; his data and those from Jenkins' survey are combined in Figure 4.2. As both authors present data for estates only, points have been located in the centre of these areas with the use of maps of estate boundaries produced by Millman (1969, 1970). Although not directly comparable because of differences in methodology, the surveys carried out by Taylor and Jenkins do indicate an expansion of range since 1914.

4.2 The first provisional distribution maps of British mammals (including the wildcat) were produced for the period 1960 - 1969 from the results of a recording programme organised by the Mammal Society (Corbet 1971). The map for the wildcat is reproduced in Figure 4.3. Subsequent distribution maps were produced for the periods up to 1976 and 1983 by the Biological Records Centre (BRC) (Arnold 1978, 1984). The latter is reproduced in Figure 4.4. However, because much of Scotland is thinly populated and much of the land remote, such recording schemes are likely to have underestimated the extent of the wildcat population.

4.3 The series of maps comprising Figures 3.1, 3.2, 3.3, 4.1, 4.2, 4.3 and 4.4, drawn from data collected partly fortuitously and later from relatively small-scale surveys, do support the suggestion of a continuous expansion in geographical range, starting during or soon after the 1914 - 1918 war and progressing, possibly at varying rates, until the 1960s. They give no idea of area status or trends in status.

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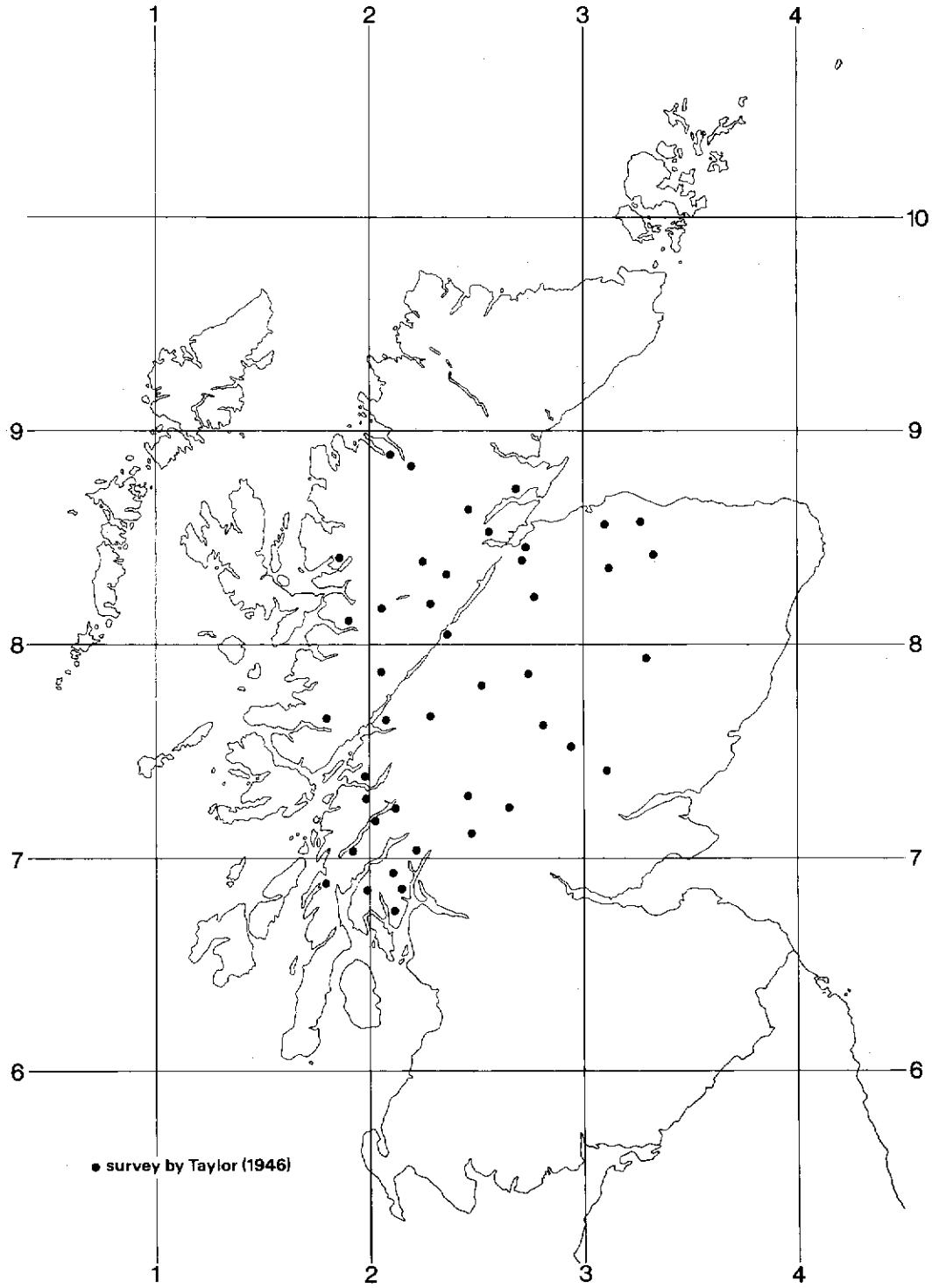


Figure 4.1

Site records of wildcats on Forestry Commission properties in Scotland, from survey by Taylor (1946)

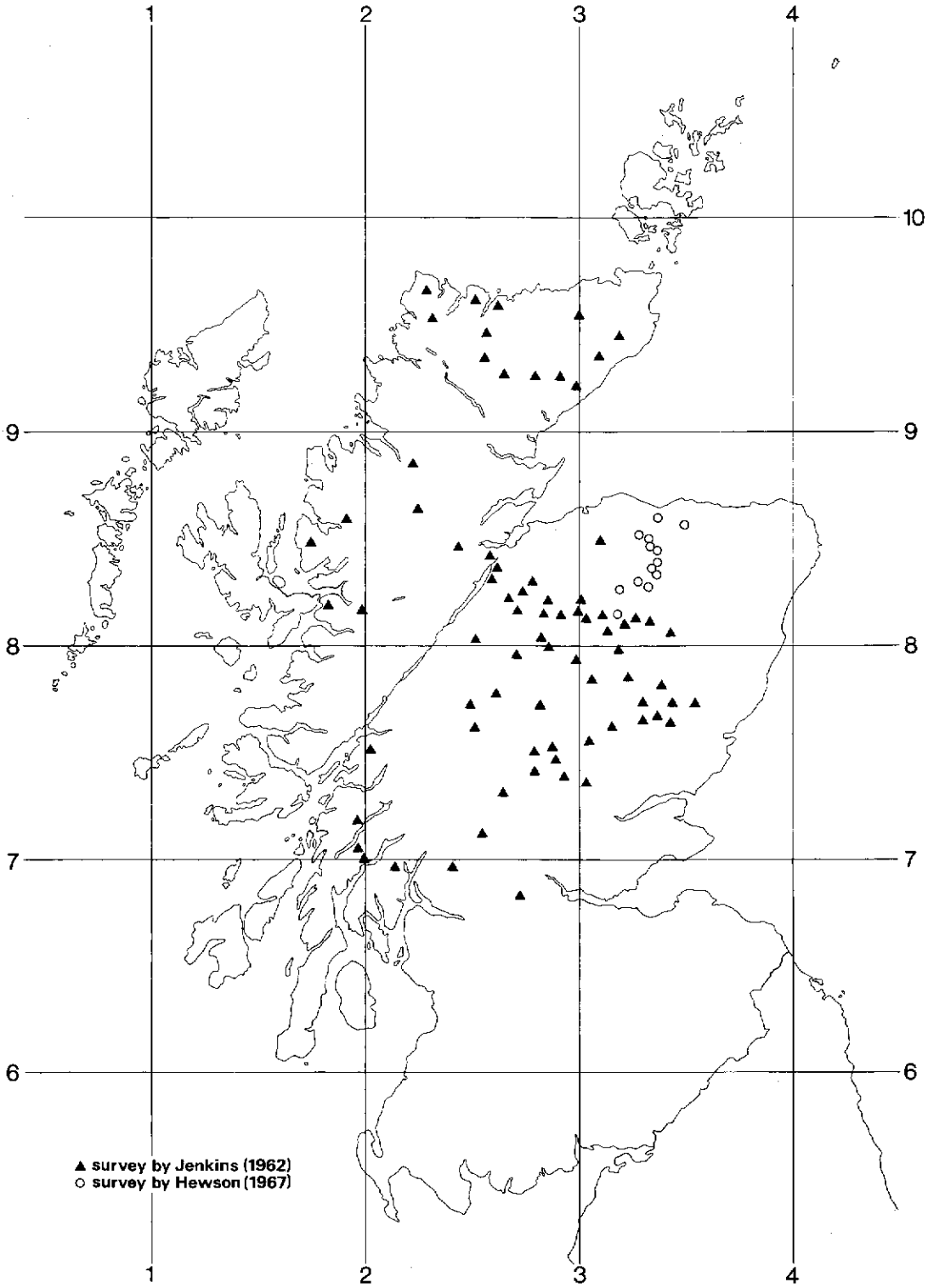


Figure 4.2

Site records of wildcats from surveys by Jenkins (1962) and Hewson (1967)

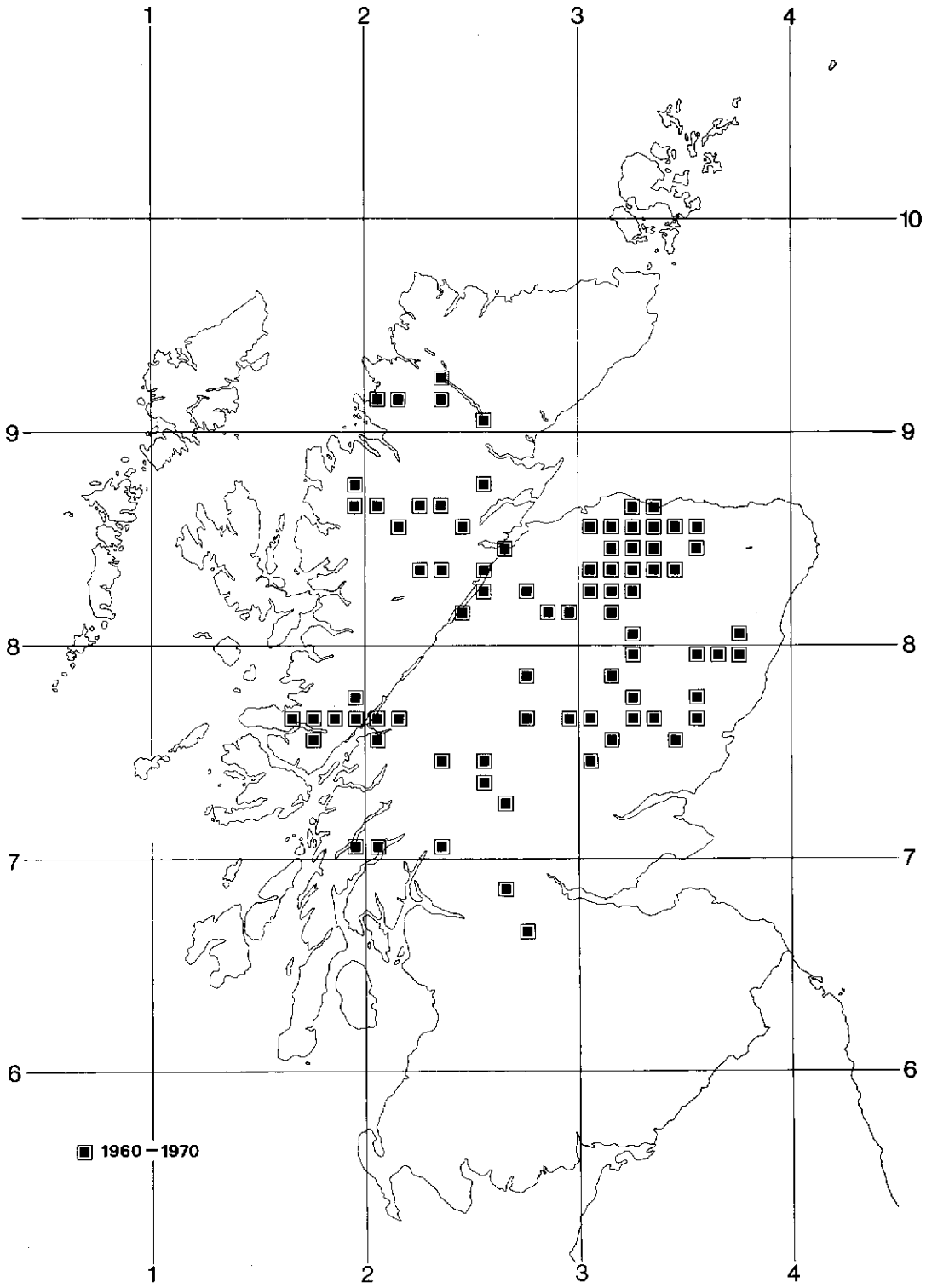


Figure 4.3

The distribution of the wildcat for the period 1960 - 1970, from Corbet (1971)

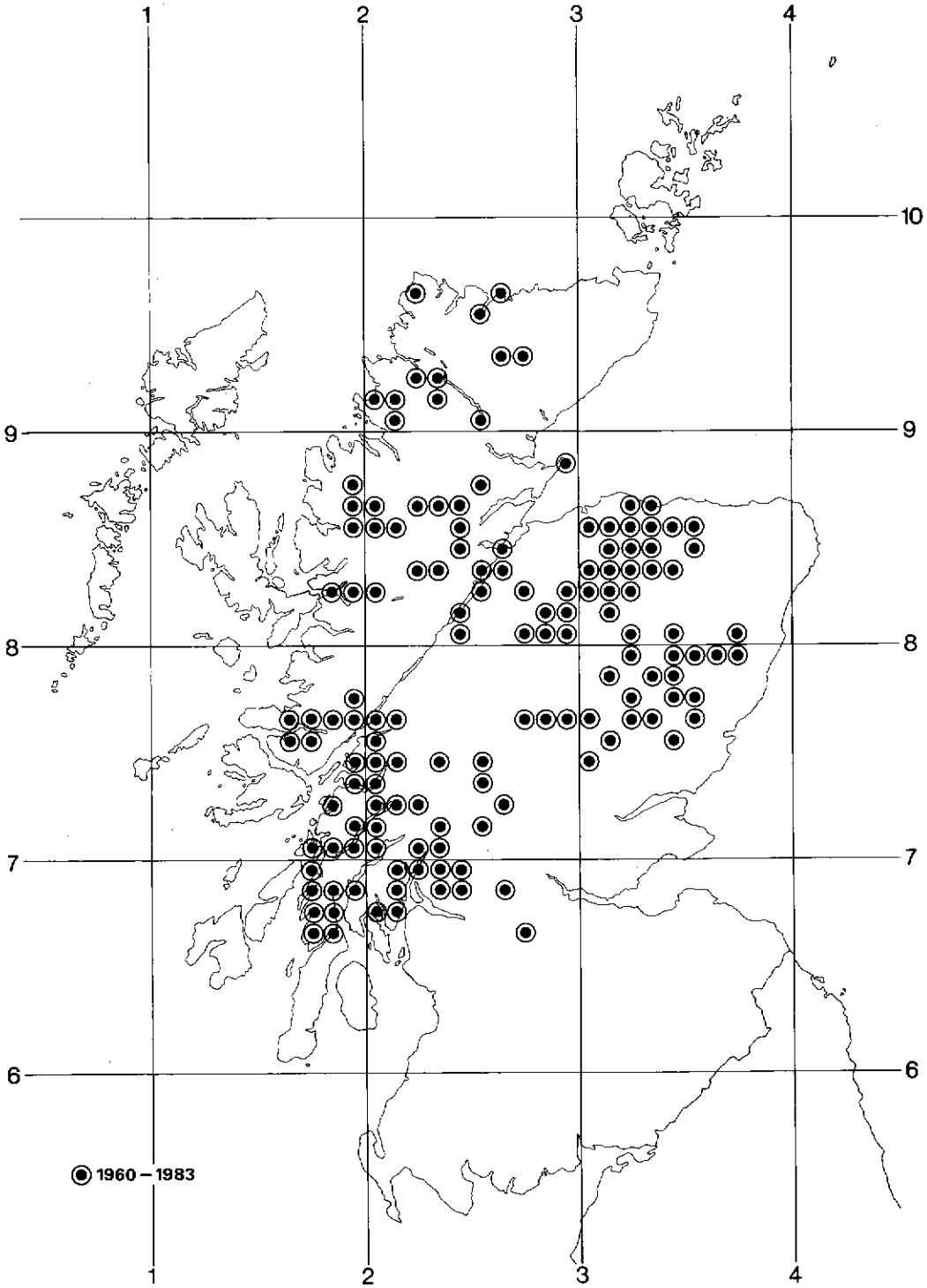


Figure 4.4

The distribution of the wildcat for the period 1960 - 1983, Biological Records Centre (Arnold 1978, 1984)

5 The Nature Conservancy Council survey

5.1 Objectives of the survey

5.1.1 To establish a baseline of status/ distribution against which the results of subsequent surveys could be compared, either on a local or on a national scale.

5.1.2 To design and adopt a simple and repeatable method of collecting information to facilitate future surveys.

5.1.3 To complete the survey in as short a time as possible, to avoid any problems arising from fluctuations in numbers during the survey period.

5.1.4 To collect and present the data in a systematic manner to be consistent with other national recording schemes, for example BRC's.

5.2 Methods

5.2.1 There are several methods by which trends in population status and distribution can be established for uncommon animals. The main ones are:

(i) use of hunting, game or predator bags,

(ii) systematic survey of specific areas (e.g. 1 km squares when surveying for badgers (Cresswell *et al.* 1989)) or transects (e.g. 600 m walks when surveying otters (Lenton *et al.* 1980)), uniformly distributed over the national grid, looking for signs (e.g. faeces, prints, setts) of the species concerned, and

(iii) determination of numbers and sites, by sightings and corpses from road traffic accidents and by interview and questionnaire.

Combinations of techniques (e.g. (ii) and (iii)) can be used. Also one or two full-time professional surveyors can be employed to carry out the surveying for (ii), or many volunteers can be used (again for (ii)), or interviews of experienced people can be carried out (for (iii)). The technique used depends on the problems associated with the species concerned, as indicated below.

(i) Hunting records were used by Chanin & Jefferies (1978) to determine the timing and geographical extent of the sudden decline in the otter population which started in 1957-1958 (i.e. to check back into the past). This technique was valid in this case because a standard unit of hunting effort per catch, i.e. numbers found per 100 days of hunting, could be calculated in order to compare hunting success between areas and dates.

(ii) When mammals are secretive and largely nocturnal and observations are likely to be few, detection by sightings will be a time-consuming matter. This problem was encountered with the otter and the pine marten, and an alternative approach to direct observations has been adopted for population surveys of these species. Indirect signs of presence (e.g. prints and faeces) were used extensively in the national surveys of the pine marten (Velander 1983) and otter (Crawford *et al.* 1979; Lenton *et al.* 1980; Green & Green 1980, 1981, 1987; Chapman & Chapman 1982; Andrews & Crawford 1986) and for some felids in other countries, e.g. puma *Felis concolor* (Berg *et al.* 1983; Van Dyke *et al.* 1986) and clouded leopard *Neofelis nebulosa* (Rabinowitz *et al.* 1987).

(iii) Questionnaires, sent to people in the field who were surveying water-birds, were used to obtain an immediate idea of trends in sightings of a common mammal, the water vole *Arvicola terrestris*, over a five year period (Jefferies *et al.* 1989). They provided information on trends quickly, while a long-term survey was being organised. Questionnaires and interviews were used in the pine marten survey of England and Wales (Strachan *et*

al. 1990), in support of field surveys based on signs, in areas where martens are extremely rare. Here even searching for signs proved to be very time-consuming for the few results obtained. The accumulated experience of observant people working in the field considerably supplemented the field exposure time of the single surveyor.

The collection of data on the distribution and status of the wildcat presents particular problems. This species is shy, cryptically coloured and mainly crepuscular and nocturnal; sightings are invariably made by chance, and people living in wildcat range may never see one. Furthermore, wildcats live at low density, especially in areas where prey is scarce, which further reduces the likelihood of encounters. The available techniques for surveying this animal were considered one by one.

(i) The use of data on predator control

The wildcat had been shot and trapped as a predatory pest for many years prior to legal protection in 1988. Data are available from the Game Conservancy's 'vermin' returns (J Tapper pers. comm.) on the numbers of wildcats shot or trapped on a number of estates from 1960 to 1985. The problems with using these data to indicate long-term trends in wildcat status and distribution are that: (a) they are not evenly distributed over wildcat range, and so cannot indicate the true distribution; (b) unlike the data for the otter, where the number of days of hunting effort expended for each catch was known, the data on the wildcat were not collected with a known or an even and substantive effort; (c) they will be density-dependent (as a greater number may be shot when more are present); (d) provision of these data will cease with legal protection after 1988.

(ii) Systematic survey by area or transect

In this case, from what has been written above, it was clearly impractical for one or two full-time observers to look for wildcats in the hope that contacts would be made, particularly because of the large area of Scotland that needed to be surveyed - 50,000 km^2. Even if many full-time observers had been available, which would have been very expensive, the secretive nature of the wildcat would make its detection by sightings a very time-consuming and inefficient way of surveying. At first sight then, the use of a full-time surveyor looking for signs, tracks and faeces, as used for the otter, would appear to be the best approach to adopt for a survey of the wildcat. Unfortunately, however, there are problems of distinguishing between wildcat tracks and those of domestic and feral cats, because of the overlap in paw-size. Furthermore, Corbett (1979) considered that it was not usually possible to distinguish between wildcat and domestic cat faeces.

(iii) The use of sightings and observations of road casualties

The advantage of these is that they enable differentiation between wildcats (or close hybrids) and domestic/feral cats and obvious hybrids, which no other method can. As sufficient visual observations could not be obtained by one or two full-time surveyors, this meant that the survey had to capitalise on the field experience of many observers who are in the field for many hours on most days. An additional advantage of this approach is that it is possible to obtain some information on population trends in specific areas from the past experience of these same observers. We adopted this method so that we were able to obtain information on the status as well as the distribution of the wildcat. If such a methodology, based on interviews, had not been adopted then it would have had to be accepted that there would be no way of obtaining information on the changing status of the wildcat. This alternative was felt to be unacceptable, and we considered that, on completion, the results and coverage obtained justified development of the technique used.

5.2.2 The survey was publicised by means of a press release to national newspapers and by means of 200 posters, requesting information, which were distributed throughout Scotland to Forestry Commission offices, RSPB reserves, NCC offices, National Trust for Scotland properties and local shops. NCC staff and field staff of the Forestry Commission were asked to report any recent records of wildcats. These measures produced some results, but the press release, in particular, highlighted the problem that many people were unsure how to distinguish between genuine wildcats and domestic/feral cats. While records from the south of England could be discounted, those from the north of England and southern Scotland, as well as in known wildcat range, had to be given careful consideration. This proved to be very time-consuming. A simple questionnaire was devised to deal with postal records, in order to check on their reliability.

5.2.3 The use of questionnaires was restricted to dealing with the small number of postal queries that were generated by the publicity outlined above and for assessing the situation in southern Scotland (Figure 3.1, area B) (see Section 5.2.4). In exceptional circumstances information was obtained by written request; this approach was adopted only for specific areas, where a person was known to possess the information required. The bulk of the records, however, were obtained by visiting and conducting personal interviews with gamekeepers, forest rangers, fox-hunters and hill shepherds. These people were selected because they live in potential or known wildcat range and because their work takes them out-of-doors by day and night in areas where wildcats are likely to be found. They are, therefore, the most likely people to see wildcats and to be able to give an opinion on the status of this animal in a particular area. Staff of the NCC and amateur naturalists were also consulted and provided a significant number of records.

Personal interviews are likely to produce better results than the use of questionnaires, which may not be returned at all or may not be filled in correctly, particularly if answers to a number of detailed questions are required.

5.2.4 At the beginning of the survey anecdotal information suggested that wildcats might be present in south Scotland (Figure 3.1, area B - south of Glasgow and Edinburgh). The Forestry Commission and Economic Forestry Group are both major land-holders in the area, and field staff of both organisations were alerted to the survey, and asked to keep a look-out for any animals which could have been wildcats. In addition, questionnaires were sent out to selected landowners, farmers and shooting interests over a wide area of south Scotland. Corpses from south Scotland of cats reported to resemble wildcats were also checked for authenticity.

5.2.5 The survey was started in July 1983 and was completed in the five years to September 1987. Only dated records for the period 1980 - 1987 were used in this analysis.

5.2.6 An archive has been established of all the people contacted or who volunteered information and of the location of all records of wildcats; this material can be referred to in any subsequent survey and should ease the task of data collection.

Results and discussion

6

6.1 Coverage

Potential wildcat range in Scotland was covered comprehensively, with information collected from 499 ten km squares north of the central Scottish lowlands (Figure 6.1 and area A on Figure 3.1). While almost all land was covered in the north and west, the more intensive lowland agricultural areas in east Scotland were not completely covered. Negative records on the edge of such areas usually defined the boundary of search, and the 10 km squares beyond this limit, in intensive agricultural land, have been assumed to be negative (the 'inferred negative squares' in Table 6.1). The southern boundary of the survey was similarly defined by the presence of lowland agricultural land and urban and industrial areas. In total more than 400 people were consulted or volunteered information during the survey.

6.2 Distribution and status

6.2.1 The distribution of the wildcat in Scotland is shown in Figure 6.2. Wildcats are widely but unevenly distributed throughout central and northern Scotland.

For ease of interpretation of the results, the main survey area has been subdivided by the use of the 100 km grid of the Ordnance Survey (Figure 6.3). In each of these sub-units the total number of positive and negative 10 km squares is expressed as a percentage of the total number of 10 km squares surveyed (see Table 6.1).

The highest percentage of squares with wildcats (positive and probable records combined) is in sub-unit NM, followed by NJ and NH. The lowest percentages of positive records are found in sub-units NS and NG.

The choice of the 100 km squares of the Ordnance Survey, although convenient for subdivision of the survey area for the interpretation of the results, inevitably leads to the occurrence of significant variation in climate, geology and topography within, as well as between, individual sub-units; all of these will contribute to the observed distribution of wildcat records. Such variation is examined below (Section 6.5).

6.2.2 Status in 10 km squares was assessed, where possible, on the basis of the number of records of wildcats made during a minimum of five years before the interview. Confirmation is available for 264 (89%) of the positive squares; not all contributors were able to supply past records; for example, some did not have a sufficiently detailed knowledge of the area, or had not been resident long enough.

Each 10 km square was assigned to one of the following categories:

Established - wildcats regularly recorded each year.

Occasional - wildcats infrequently recorded; one or two records per year.

Rare - wildcats rarely seen, with only one or two records at most during the previous five years.

Rare/absent - last record at least five years ago and no further signs of wildcats in the area.

In some 10 km squares records were available from different sources. If there was any variation in the reports of status for different parts of the same square, the highest category (Established> Occasional>Rare>Rare/absent) overall has been adopted. This means that status is not underestimated; if anything the reverse is true.

Status records for each sub-unit of the survey area are presented in Table 6.2.

To illustrate the present geographical variation in wildcat status we calculated a

6

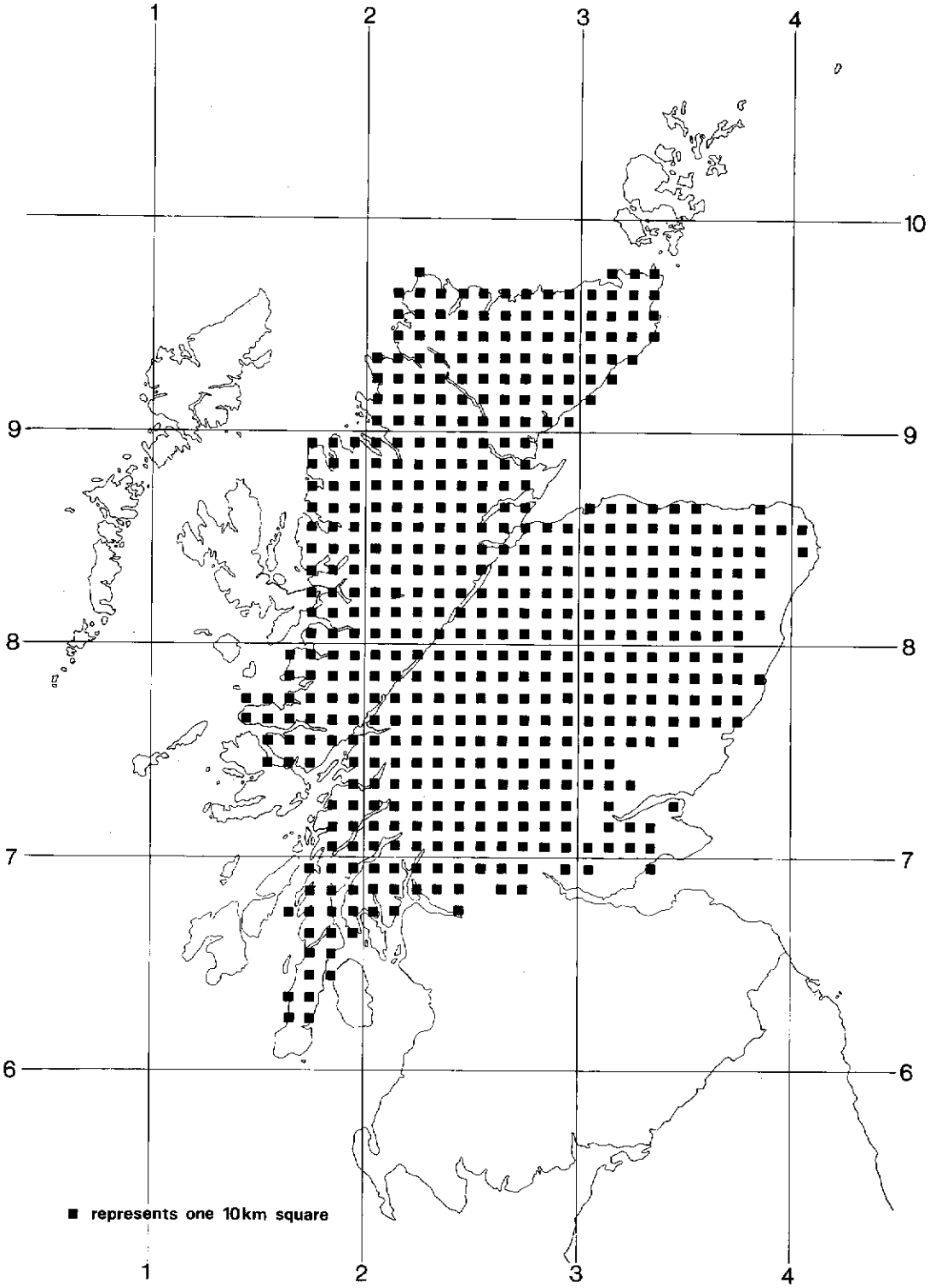


Figure 6.1

Coverage by the survey of 10 km squares in Scotland

Table 6.1

The percentage of positive and negative 10 km squares in each sub-unit of the survey area. (Figures in parentheses [ ] are the number of squares assumed to be negative in a sub-unit and x = number of 10 km squares.)

OS 100 km Grid square	No. of 10 km squares surveyed/ total no. of 10 km squares	% positive squares	% probable squares *	% negative squares
NC	68/68	48.5 x=33	5.9 x=4	45.6 x=31
ND	21/21	47.6 x=10	14.3 x=3	38.1 x=8
NG	30/32 [2]	37.5 x=12	3.1 x=1	59.4 x=19
NH	93/96 [3]	64.6 x=62	3.1 x=3	32.3 x=31
NJ	60/70 [10]	71.7 x=43	0.0 x=0	38.6 x=27
NM	36/39 [3]	69.2 x=27	7.7 x=3	23.1 x=9
NN	100/100	57.0 x=57	2.0 x=2	41.0 x=41
NO	47/70 [23]	51.4 x=36	1.4 x=1	47.2 x=33
NR	21/25 [4]	44.0 x=11	4.0 x=1	52.0 x=13
NS	19/25 [6]	24.0 x=6	4.0 x=1	72.0 x=18
Overall	495/546 [51]	54.4 x=297	3.5 x=19	42.1 x=230

Key

*Probable squares are those for which we received information suggesting wildcats were present in a 10 km square, but could not be accepted as establishing beyond reasonable doubt that wildcats were present. Four squares in NK and NT are not included in the analysis.

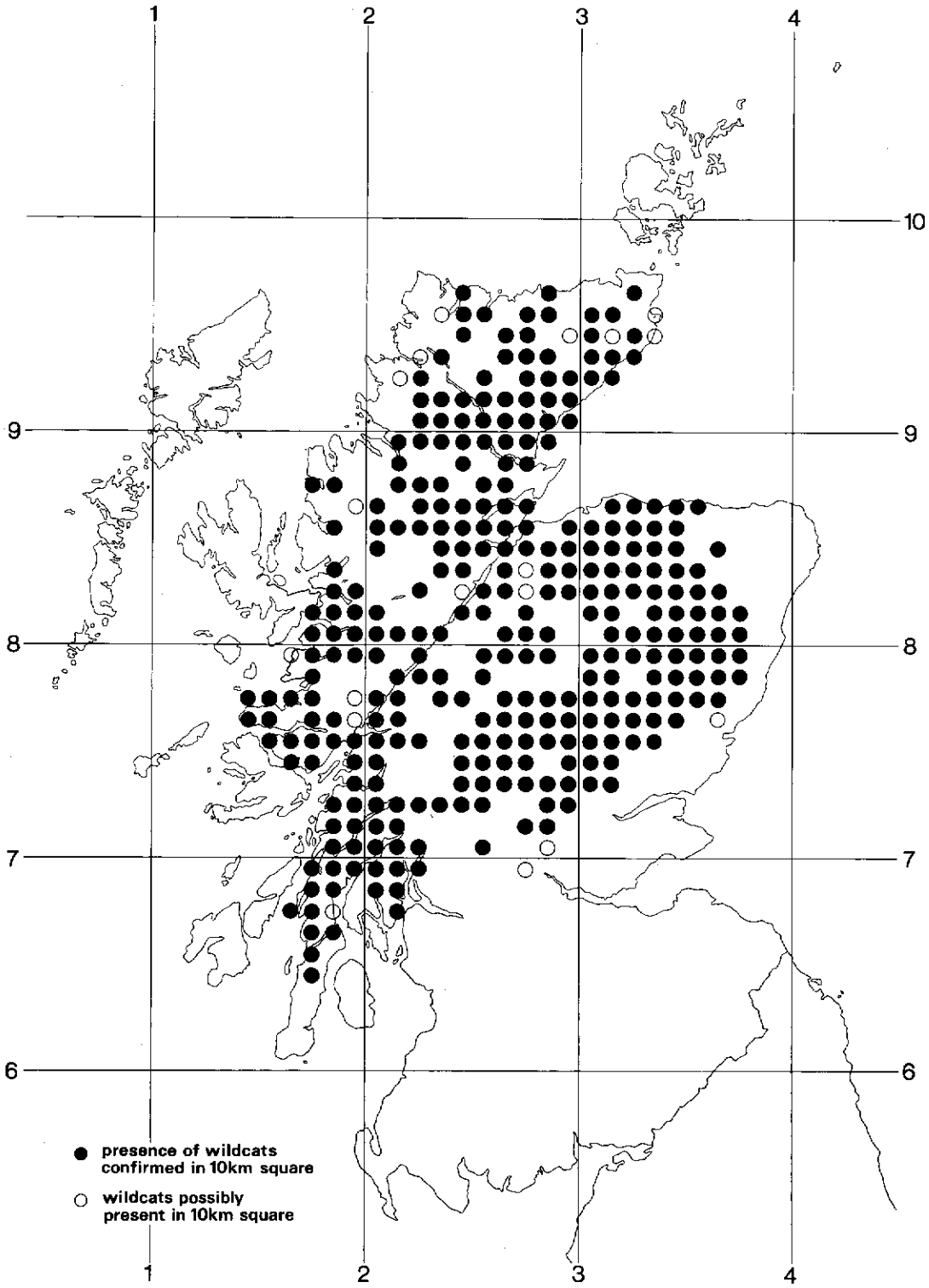


Figure 6.2

The distribution of the wildcat in Scotland in 1983 - 1987

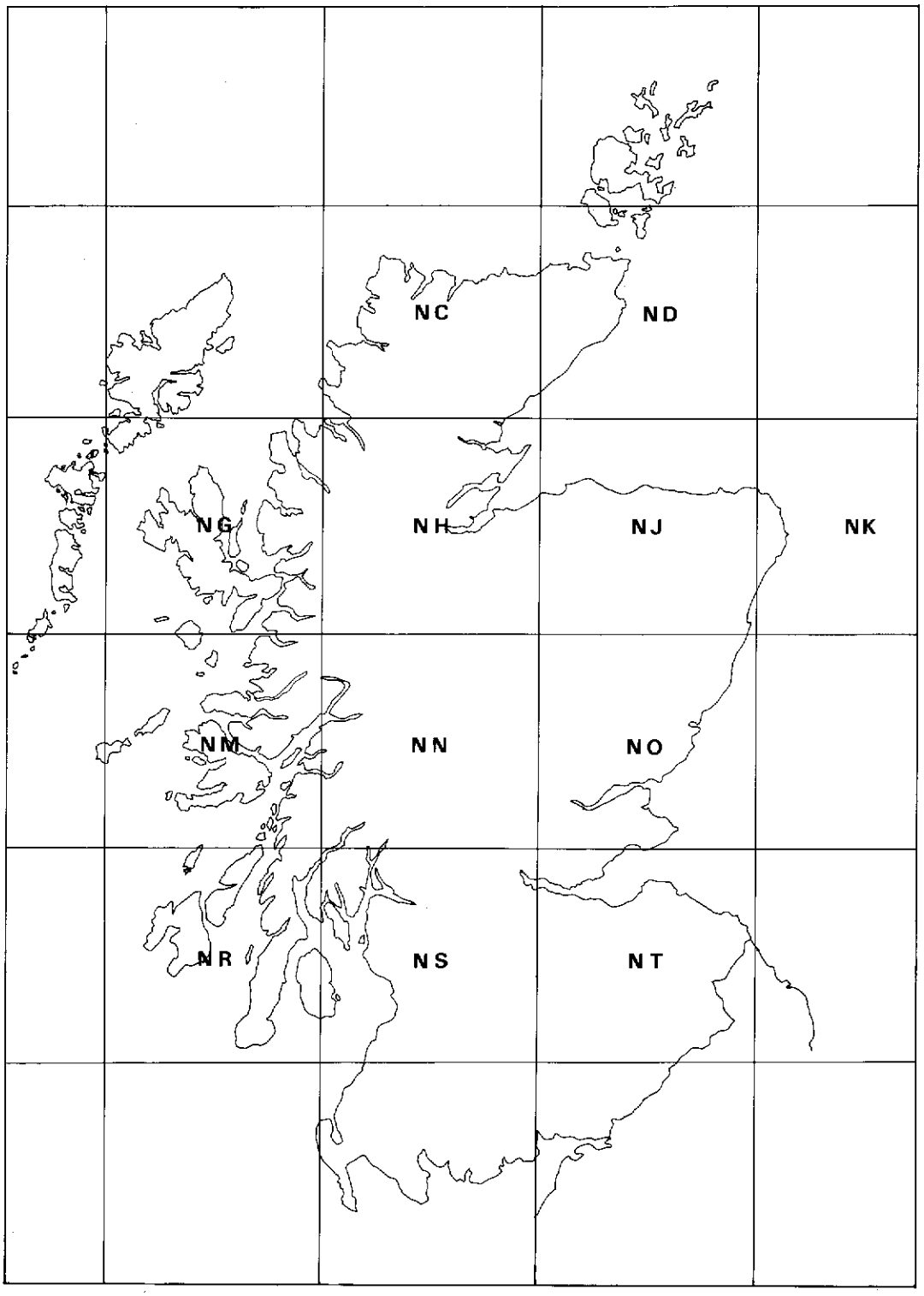


Figure 6.3
The subdivision of the survey area by 100 km Ordnance Survey grid squares

mean status score for areas of 3 x 3 ten km squares, i.e. 900 km^2. These units of area are large enough to provide a mean status score (i.e. the mean of the nine included 10 km squares), but small enough to show gradation across the country from east to west and from north to south. Status scores were assigned to each 10 km square as follows: absent = 0, rare and rare/absent = 1, occasional = 2, established = 3. Reports of wildcat presence in a 10 km square, but lacking status information, arbitrarily scored 1.5.

Thus the mean score for an area unit = total of 10 km square scores in area unit divided by total no. of squares in area unit. These scores were used to draw Figure 6.4. Wildcat status is highest in the north-east, east and south-west of the survey area, and lowest in the north-west and the western Grampian mountains. It is of interest to compare this picture of status with the estimated distribution when the population was at its minimum earlier this century, the south-eastern boundary of which is shown as the heavy line in Figure 6.4. The area occupied at the population minimum, and thus with the longest unbroken period of occupation by wildcats, encompasses what is now the low status area in the north-west. It is only in the southern part of the range occupied in 1915, in west Lochaber, that wildcat populations are found at moderate density, as reflected in the status scores. The survival of the wildcat in the relict area in the north-west of Scotland at the turn of the century is apparently the result of the remoteness and low human population density of the area, and hence low levels of persecution; it seems not to have been due to the high quality of the habitat, which current population status suggests is poor. Expansion to higher status populations has generally occurred outside the pre-1915 relict area.

6.3 South Scotland

No evidence was obtained to confirm that wildcats were present in Scotland south of the central industrial belt. Interviews, inspection of dead animals, questionnaires to estates and shooting syndicates (n = 18) and publicity of the survey failed to produce any authenticated records. North (1977) reviewed reports of wildcats from south Scotland and mentions a specimen from Firknowe near Airdrie, which was killed on the road in 1960. The corpse was donated to a museum but has been lost. Inspection of a photograph of this animal indicates that it could have been a wildcat, but it is not always possible to confirm identification without a detailed examination. It was a young male animal and could have been dispersing from the nearest area of wildcat range, which at that time was probably the Carron valley in Stirlingshire. This is a distance of approximately 15 km, which is not great in relation to the distances that wildcats have been observed to cover in a single night, for example >16 km (J Robertson pers. comm.). It is possible that this record represents merely the movement of a young male away from its natal site through an area of unsuitable habitat.

How often such events occur is unknown, and most corpses of cats beside a road are unlikely to generate much interest. A further road casualty reported by North (1977) was found at West Linton, Peebles-shire, in 1975. This specimen had been handed in to the Royal Museum of Scotland and was available for examination; it proved to be a domestic cat.

All other specimens from south Scotland that have been examined have likewise proved to be domestic cats. The extensive areas of young conifer forest in south Scotland could support wildcats, and if recolonisation had taken place it seems very unlikely that these animals would not have been seen by Forestry Commission or Economic Forestry Group staff (most FC rangers in south Scotland and EFG staff also having been contacted) or by any of the other persons approached during the survey.

Table 6.2

Status of wildcats in each sub-unit of the survey area. (Figures in parentheses are the number of positive squares.)

OS 100 km grid square	No. of squares surveyed	% of positive squares with status records	Estab. %	Occ. %	Rare %	R / ab. %
NC	68 (33)	94	19	58	23	0
ND	21 (10)	100	50	50	0	0
NG	30 (12)	92	9	36	55	0
NH	93 (62)	89	12	54	32	2
NJ	60 (43)	84	33	45	22	0
NM	36 (27)	74	5	80	15	0
NN	100 (57)	93	8	40	41	11
NO	52 (36)	92	27	67	3	3
NR	21 (11)	100	0	73	27	0
Overall	476 (291)	89	18	53	26	3

Note Sub-units NS, NT and NK were not included because of the small sample size of positive squares (n = 6)

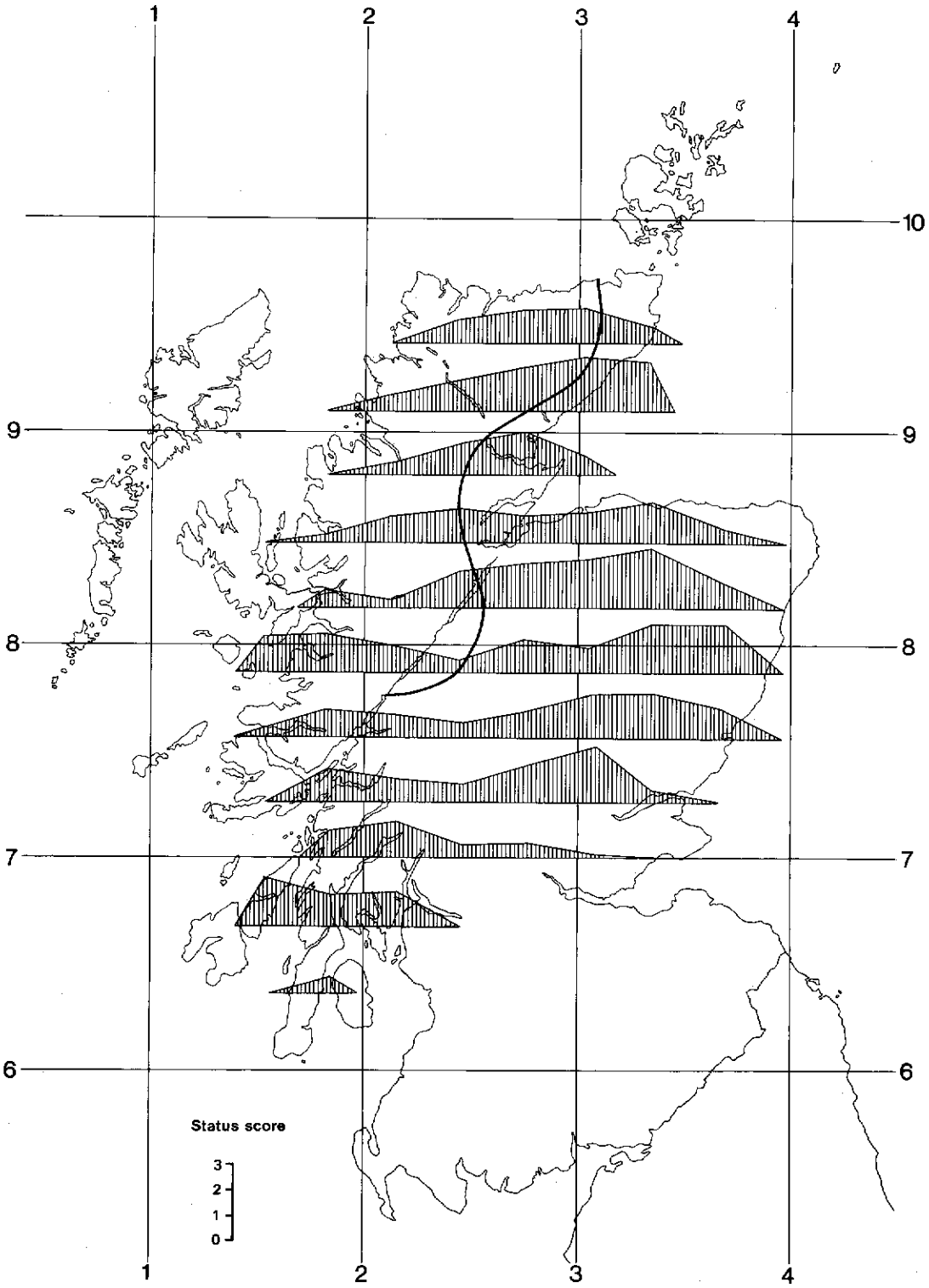


Figure 6.4

Wildcat status in Scotland - see Section 6.2.2

6.4 Population trends

6.4.1 Where possible, information on trends in wildcat populations was collected. As with the information on status, that for trends also relied on the interviewee having a thorough knowledge of a particular area extending back over a minimum of five years. Information was collected from 179 squares (60.3% of positive squares) and the 10 km squares were assigned to one of three categories - no change, increasing or decreasing. These assessments are inevitably subjective, but care was taken to establish that observer effort had been as consistent as possible from one year to the next in a given area. For example, during fox-control - an activity carried out each year - many records of wildcats are made. If the same pattern of activity is followed by a gamekeeper from one year to the next, as is often the case, and there is a diminution or an increase in records of wildcats, then it is reasonable to suggest that the population is either decreasing or increasing.

The proportions of the population falling into each of the trend categories are as follows: no change 58%, decreasing 34% and increasing 8%.

6.4.2 It is informative to see how the trend categories relate to the status of populations, e.g. in what proportion of 10 km squares where the wildcat is rare is the population apparently increasing or decreasing. Information both on population trends and on status is presented in Figure 6.5.

Some caution is necessary with the interpretation of Figure 6.5, as the actual numbers in some categories are small; the lack of any rare populations in the increasing category may reflect the rather crude nature of the status classification. Once a rare population is noticed to have increased, it may, understandably, be classified as occasional. Nevertheless, there are some trends in the figure which are worth noting. Most of the records in the established group are in the no change category, but this represents only 16% (n = 29) of the total sample. The occasional group is the largest overall, and although most records in this group are also in the no change category, 32% were decreasing. None of the populations classed as rare was reported as increasing, but, as mentioned above, this is probably a consequence of the classification. While 56% of records in this group were in the no change category, 44% were classed as decreasing. Thus the picture which emerges from these results is that most populations of wildcats in Scotland in each status group are currently showing little change. Relatively few population increases were recorded, mostly in the established group, while the occasional and rare groups showed little increase but significant levels of decrease, of 32% and 44% respectively.

6.4.3 The trend and status information discussed above reveals that populations on the edge of wildcat range and in the central part of the survey area are generally of low status and that a significant proportion are declining. If rare populations were expanding, we would expect to find increases in wildcats at the edge of the range. The rate of expansion of the wildcat population appears to have peaked and it may now be starting to slow down.

6.5 Land class characterisation and the distribution of wildcats

The distribution and status of wildcats in the survey area are related to a complex of factors. The availability of food is of prime importance and has been suggested as regulating carnivore numbers (Kruuk 1972); shelter is also of significance to wildcats, particularly during winter (Corbett 1979).

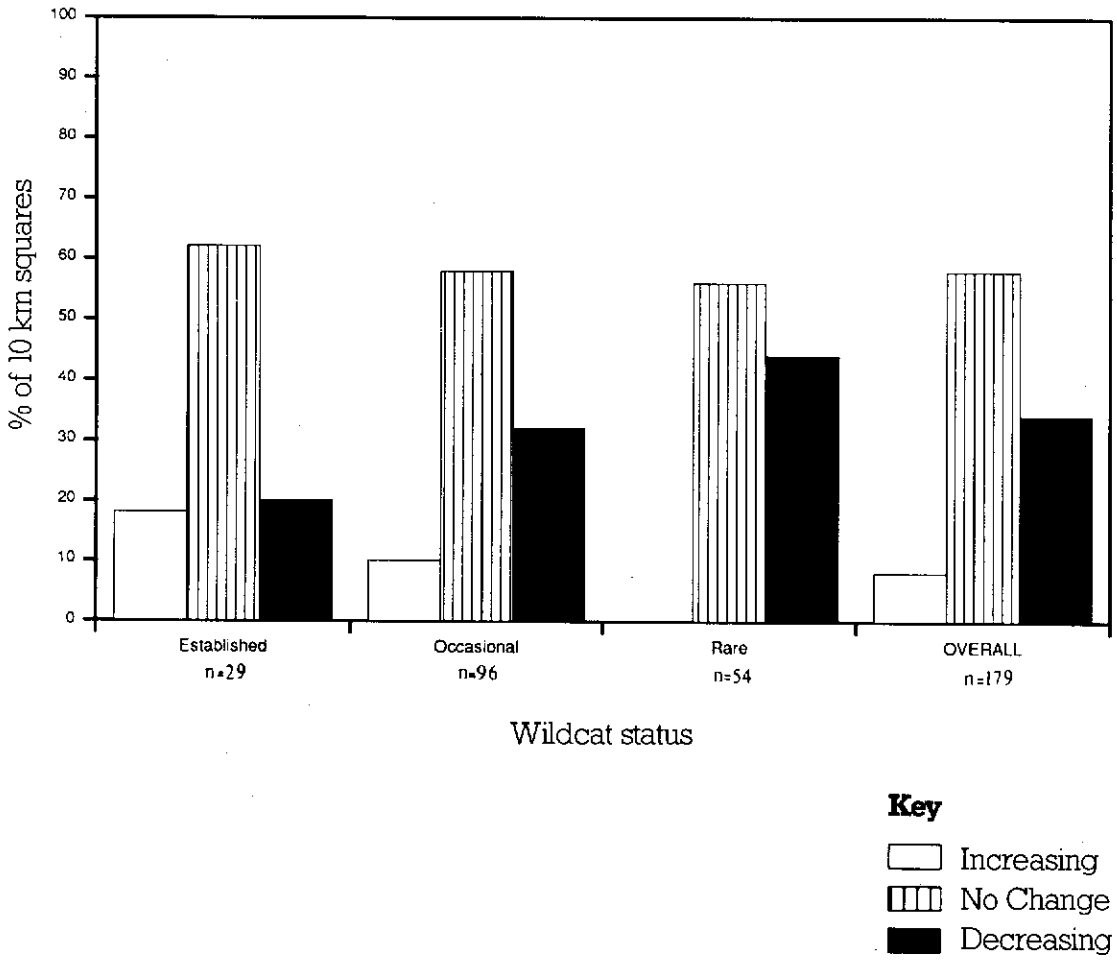


Figure 6.5
Wildcat population trends (information from 179 ten km squares)

6

There are no comprehensive data on the availability of prey for wildcats in Scotland. However, habitat characterisation, reflecting prey abundance, has been used to predict fox densities throughout Britain (Macdonald, Bunce & Bacon 1981). This was carried out on the basis of the land classification of Britain produced by the Institute of Terrestrial Ecology (ITE) (Bunce 1978, 1980). It is possible that a similar approach using the ITE land classification could explain, at least in part, the observed distribution and status of wildcats in Scotland.

The ITE land classification is based on environmental data extracted from OS maps, e.g. climate, topography, human artefacts and geology. These data are analysed to produce a land classification which is used for stratification. These strata (land classes) are then used as a basis for field survey of land-use and ecological parameters. On the basis of the information collected in the field, the land classes are redefined and the amount and distribution of particular features measured. Finally, land-use and ecological features can be predicted for areas in which only the land class is known (Bunce & Heal 1984). The land classes occurring in the survey area are described in Table A1 in the Appendix.

Although data on wildcat distribution are expressed on a 10 km square basis, records were usually collected to at least the 1 km square level. It was, therefore, possible to relate these records to ITE land class data, which are also expressed on a 1 km square basis. Wildcat records from 706 one km squares were assigned an ITE land class, either from the sample of classified squares (n = 12,281) or by extrapolation from the nearest classified squares, with reference to important map variables, e.g. elevation, or proximity to the coast. Extrapolation was not necessary for squares in Highland Region, which covers nearly half the survey area, since all 1 km squares in that region have been classified (Highland Regional Council 1985). The proportional area of each land class in the survey area was obtained from data held at ITE Merlewood Research Station.

The relationship between the distribution of wildcats and land classes was examined by the use of an index of preference, based on that derived by Duncan (1983). This index is a modification of the index of preference first used by Hunter (1962) and takes the following form:

$$P_{1i} = U_i/A_i,$$

(where: P_{1i} = Preference index for facet $_i$, U_i = % of all observations which were recorded in facet $_i$ and A_i = % of the study area covered by facet $_i$)

Duncan carried out a log transformation of P_1, to give a normalised index of preference, which avoids the problem of compression of values for facets that are not preferred relative to those that are preferred. Duncan's index takes the form:

$$P_{2i} = \log(P_{1i}+1).$$

With this index the value of 0.3 is parity; i.e. selection is equal to the amount of a particular facet; values <0.3 indicate avoidance, while values >0.3 indicate selection. The preference index for all the land classes found in the survey area is shown in Figure 6.6. The line across the figure, at 0.3, is parity, where selection reflects the availability of a particular land class.

The most frequently preferred land classes in the survey area were 28, 22 and 21, while the least preferred are 30, 26, 32, 17 and 23.

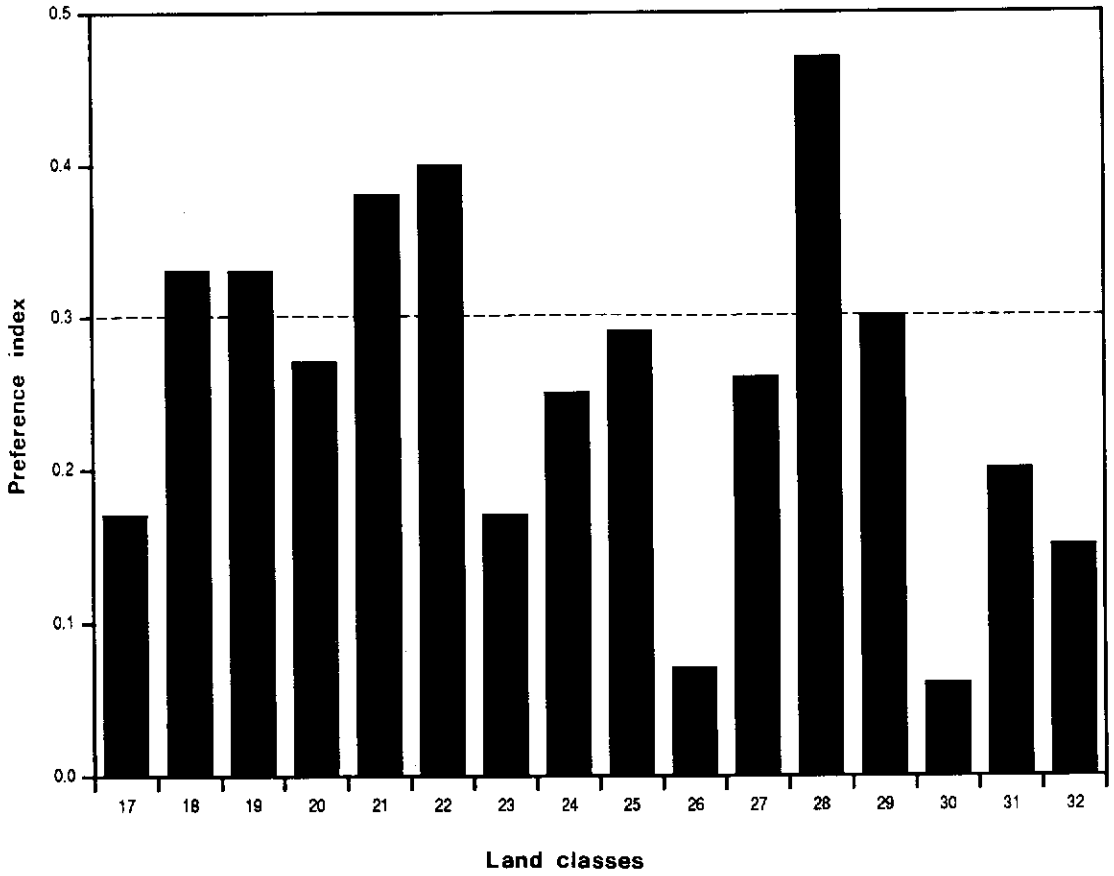
What are the features of the preferred land classes? Land class 28 is mostly confined to the east of northern Scotland,

in Inverness-shire, Easter Ross, Sutherland and Caithness. It represents the marginal edge of farmland and moorland and is subject to some afforestation. Land class 22 is more widely represented in Scotland; it consists of marginal areas between high mountains and moorlands and is often substantially afforested. The land-use is mainly rough grazing, but some crops are grown and woodlands are also present. Land class 21 is found throughout central and north Scotland; it consists of upper valley slopes with rocky outcrops and bogs. These areas are used for open range grazing and forestry. Land classes 28 and 22 are illustrated in Figure 6.7.

In contrast, the least preferred classes have the following attributes. Land class 30 is found in the extreme west of Scotland, and supports mainly peatland and moorland vegetation. The land-use is open-range grazing and crofting. Land class 26 is the fertile lowlands with intensive agriculture. It is found in the east and south of the survey area. Land class 32 consists of windswept low hills in the far north-west of the mainland and on the islands. There is some pasture, but the land-use is mostly open-range grazing. Land class 17 is very poorly represented in Scotland and is so rare in the survey area that few records of wildcats occurred in this class. Land class 23 is the high mountain summits of central and north Scotland. The vegetation is characterised mainly by peatland types with some mountain grassland and moorland. Land classes 30 and 26 are illustrated in Figure 6.8. (The use of each land class is discussed in the Appendix.)

Thus, in the east, marginal areas with moorlands, pasture land and woodlands are apparently preferred, while more generally throughout the survey area the wildcats' preference is for the margins of mountains and moorlands with rough grazing, often with forests and with some crops. In the more westerly areas, uplands with rough grazing and moorlands and limited pastures are preferred. The highest mountain areas, exposed coasts and intensive agricultural lowlands receive little use or are completely avoided by wildcats.

The selection of land classes is presumably related to the availability of food and cover. Conifer forest, particularly when young and associated with scrub, was found by Corbett (1978) to be important habitat for wildcats in north-east Scotland. He considered that the apparent increase in wildcats was related to the extensive planting of conifer forest. While preferred land classes frequently supported forests and the least preferred/avoided tended not to, some of the classes showing intermediate preference ratings also contain substantial areas of forests. Certainly the younger stages of plantation forest can be attractive to wildcats in terms of cover and the availability of prey, permitting the establishment of populations in otherwise largely unsuitable areas, for instance where there is low availability of prey and little shelter. However, as the trees grow and canopy closure occurs, the ground flora is shaded out over substantial areas, except for rides and roads. Food for herbivores also declines and Charles (1981) reported major reductions in field vole *Microtus agrestis* populations in closed forests, with densities as low as on unenclosed hill land; in some cases voles were absent altogether. Declines of wildcats in some forests in north Argyll and west Sutherland may be attributable to this cause, since alternative sources of prey outside forests are limited in these areas. Watson, Langslow & Rae (1987) found that densities of live prey for golden eagles *Aquila chrysaetos* on open hill ground were low in north-west and west Scotland. Estimated live prey availability for eagles was highest in the eastern Highlands, in Aberdeenshire and Kincardineshire, where wildcats are well established, although reaching their highest densities in the more wooded areas. The diet of golden eagles will



Key

17 Rounded intermediate slopes, mainly improveable pasture.

18 Rounded hills, some steep slopes, varied moorlands.

19 Smooth hills, mainly heather moors, often afforested.

20 Mid-valley slopes, mainly heather moors, often afforested.

21 Upper valley slopes, mainly covered with bogs.

22 Margins of high mountains, moorlands, often afforested.

23 High mountain summits,with well drained moorlands.

24 Upper steep mountain slopes, usually bog covered.

25 Lowlands with variable land use, mainly arable.

26 Fertile lowlands with intensive agriculture.

27 Fertile lowland margins with mixed agriculture.

28 Varied lowland margins with heterogeneous land use.

29 Sheltered coasts with varied land use, often crofting.

30 Open coasts with low hills dominated by bogs.

31 Cold exposed coasts with variable land use and crofting.

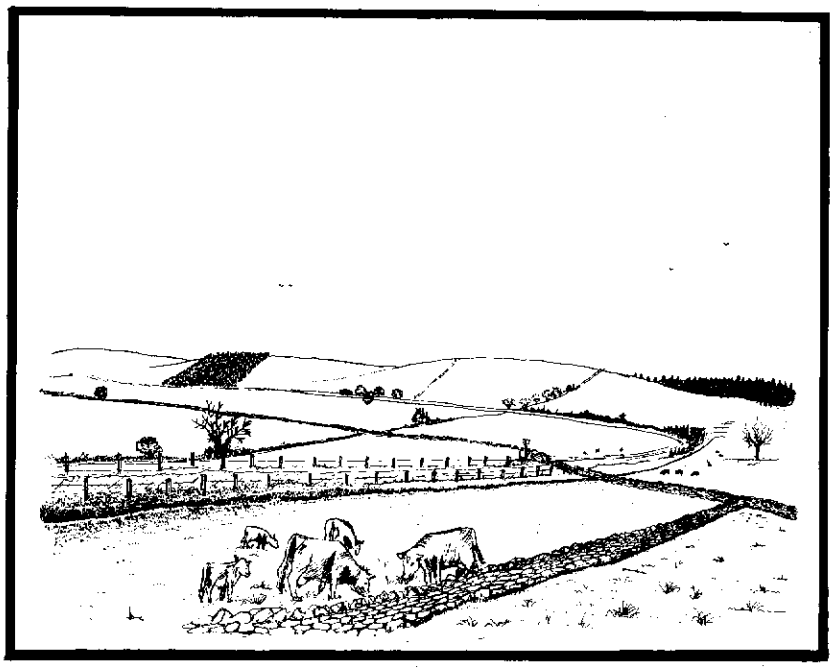
32 Bleak undulating surfaces, mainly covered with bogs.

(From Bunce, Barr & Whittaker 1981)

Figure 6.6

Wildcat preference indices for ITE land classes in the survey area

LAND CLASS 28
Varied lowland margins with heterogenous land use.



LAND CLASS 22
Margins of high mountains, moorlands; often afforested.

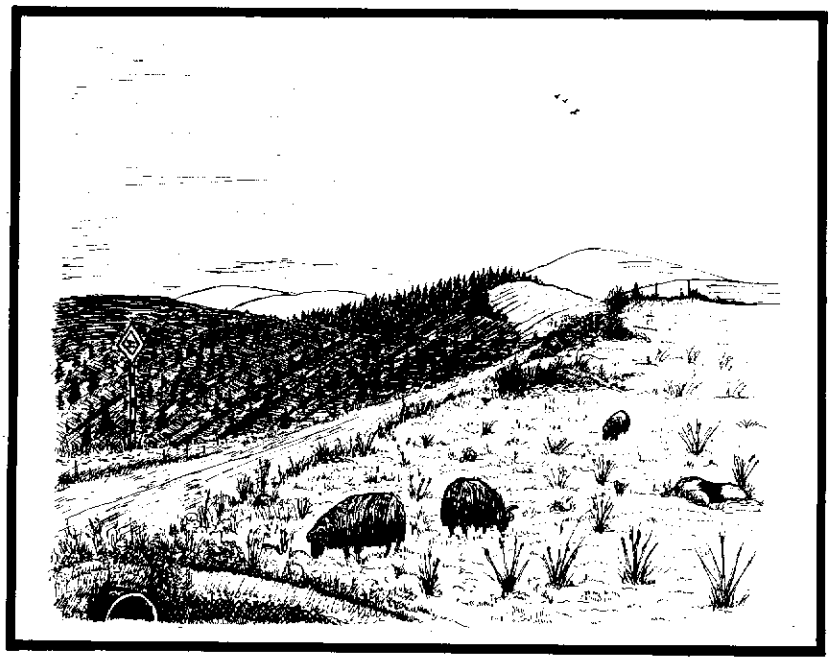
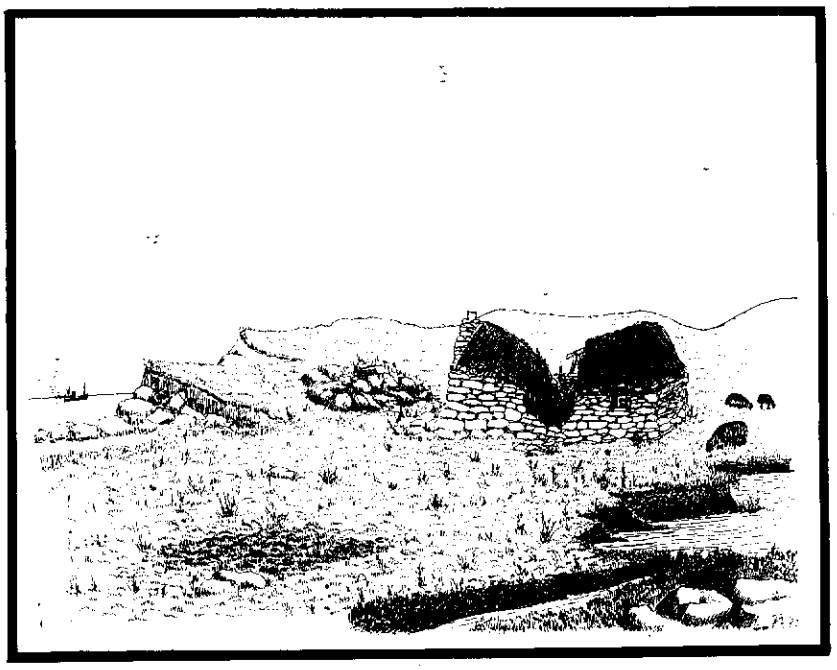


Figure 6.7

Illustrations of land classes prefered by wildcats (reproduced with permission from Benefield & Bunce 1982)

LAND CLASS 30
Exposed coasts dominated by bogs.



LAND CLASS 26
Fertile lowlands with intensive agriculture.

Figure 6.8

Illustrations of land classes generally avoided by wildcats (reproduced with permission from Benefield & Bunce 1982)

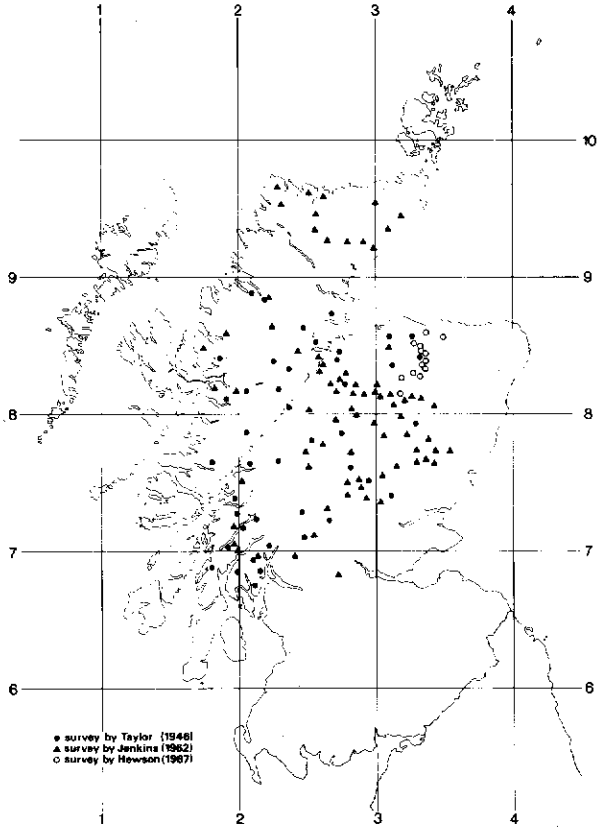


Figure 6.9a

Records of wildcats from surveys by Taylor (1946), Jenkins (1962) and Hewson (1967)

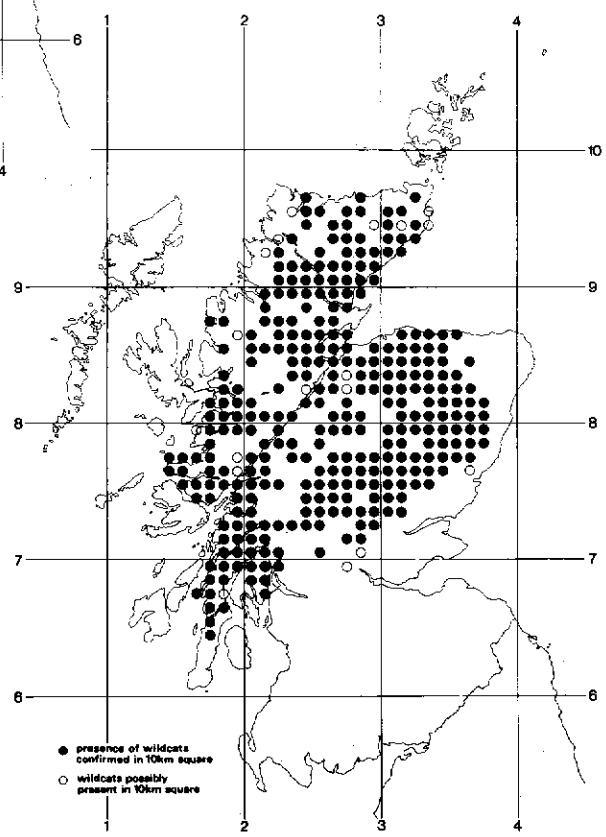


Figure 6.9b

Records of wildcats from the present survey (1983 - 1987)

show a bias towards birds rather than small mammalian prey, but lagomorphs are important to both species, and these estimates probably do give an indication of food availability for wildcats as well.

Thus the value of plantation forest to wildcats could depend not only on the variation in age-structure of the stands of trees but also on the relative abundance of prey in the surrounding area; conifer forests alone do not explain the distribution and abundance of wildcats over the whole study area.

6.6 Comparison with previous surveys

It is not possible to make direct comparisons between the distribution of wildcats obtained in this survey and the results of previous work because of differences in the way in which data were collected and variations in the areas surveyed. However, some broad generalisations can be made. Figure 6.9a combines the results of previous surveys (Taylor 1946 (Figure 4.1), Jenkins 1962 and Hewson 1967 (Figure 4.2)); Figure 6.9b shows the present survey. Inspection of this figure shows that there has been relatively little change in the overall range of the wildcat in the forty years prior to the present survey. (This assumes that the previous surveys were additive and that no significant reductions in range occurred over the 20 years between Taylor's (1946) results and those of Hewson (1967).) There are areas with records in the present survey which have been recolonised since the 1946 - 1967 data were collected, for example Ardnamurchan and Morven in west Scotland (sub-unit NM). Both were also reported as positive by Arnold (1978,1984) (Figure 4.4). Kintyre in south Argyll (sub-unit NR), is another area that has been recolonised. Presence here was confirmed by North (1977) and Bignal & Easterbee (1984). It appears that wildcats moved back into Kintyre early in the 1970s after an absence of over 60 years. However, most of the variation between Figures 6.9a and 6.9b is in the density of records within a given area. There are two possible explanations for this: either the greater recording effort and systematic cover in the present survey have led to a greater number and wider distribution of records or wildcats have spread locally and are now more generally distributed than 20 years ago. Both are probably true.

Comparison of the results of the present survey with the maps (Figures 4.3 and 4.4) produced by the Biological Records Centre for 1960 - 1970 and 1960 - 1983 (Corbet 1971; Arnold 1984) are more difficult, as these were not constructed from the results of systematic survey but from opportunistic sightings. There is a tendency, therefore, for sightings to be recorded where observer density is highest. However, these two decades (1960s and 1970s) are of considerable interest as they cover the period immediately before the present survey (1983 - 1987), for which there are no alternative data. Both BRC (Figure 4.3) and the present survey (Figure 6.2) agree on the scarcity of records in the western Grampians and West Highlands. Wildcats were reported to be absent or, if present, generally rare in these areas. Chance sightings are, therefore, unlikely and our results support those of Arnold (1984) in this respect. However, a detailed examination of the BRC maps (Figures 4.3 and 4.4) and that of the present survey (Figure 6.2) in terms of the locations of positive 10 km squares shows a greater degree of difference than would be expected if the situation had remained constant in these two decades. Thus one would have expected that the 80 positive squares recorded by BRC in 1960 - 1970 would have all, or nearly all, fallen within the 303 positive squares recorded in the present larger survey of 1983 - 1987; but 22 (or 27.5%) of the former are unrepresented in the latter. Similarly, of the 60 positive squares recorded by BRC for 1970 - 1983, 17 (28.3%) were unrepresented as such in the 1983 - 1987 large survey.

This means that 39 of 140 squares (27.9%) recorded as having wildcats present in the 1960s and 1970s apparently no longer had in the mid-1980s. Local extinctions appear to have taken place largely in peripheral squares but losses of wildcats are particularly notable in parts of west Sutherland and west Stirlingshire, where they were recorded 20 to 30 years ago. Some of the declines in wildcats appear to have coincided with crashes in rabbit *Oryctolagus cuniculus* populations, through myxomatosis.

The recovery of rabbit populations in Scotland after outbreaks of myxomatosis has not been so marked as it has been in east and south-east England (Tapper 1985); in some isolated areas of Scotland rabbit populations have still to recover from the initial impact of this disease. Similar declines in the populations of other predators of rabbits, for example stoat *Mustela erminea*, have also been observed after the arrival of myxomatosis (Jefferies & Pendlebury 1968). Tapper (1977) reported that stoat populations in England had increased after the recovery of the rabbit population in East Anglia. However, in the north of England, where rabbit populations had not increased to the same extent, the increase in stoats was significantly less.

The only other information available on the distribution of the wildcat is from the five-yearly survey of damage to its forests produced by the Forestry Commission. The most recent report (Tee, Rowe & Pepper 1985) supports the picture of distribution which has emerged from this survey.

6.7 Persecution

Information on persecution was collected whenever possible during the survey. The presence of persecution was ascertained from direct evidence, that is, corpses of animals that had been snared or shot, or from the evidence of gamekeepers and other people who were interviewed. Evidence for the lack of persecution was difficult to assess, since predator control is a potentially contentious issue and thus information may not be readily volunteered. Furthermore, records of lack of persecution in part of a 10 km square do not necessarily apply to the whole of that square, though they have here been included as if they did, unless there were grounds for doubt. Records which are in any way doubtful have been excluded. Thus records of "no apparent persecution" have been categorised as showing no direct evidence that it is taking place. This means that persecution is not being overestimated; in reality persecution is likely to be underestimated in these circumstances.

Records of persecution are presented in Table 6.3.

Wildcats were evidently persecuted in 98 (62%) of the 10 km squares for which information is available: 19% of persecution occurred to established populations; the remaining 81% occurred to lower density populations, in the occasional and rare categories. It can be seen in Table 6.3 that, despite small sample sizes in some of the western sub-units, there is a noticeable trend towards higher levels of persecution in the eastern part of the survey area, particularly in sub-units NJ and NO. These records show a link with the distribution of sporting estates, particularly where red grouse *Lagopus lagopus* and pheasants *Phasianus colchicus* are shot. However, in the west of Scotland, where gamebirds are scarce and there is a greater emphasis on deer-stalking, persecution was still taking place, with records from west Sutherland, Wester Ross, western Inverness-shire and Argyll. While the levels of persecution in the east of Scotland were not unexpected, levels in the west were higher than expected. Persecution of the wildcat in many western areas can only be explained by

traditional prejudice against predators which persists from the nineteenth century. The continued persecution of low-density populations may lead to localised population declines and even extinctions, since many of these populations are small and isolated. Recolonisation of areas in the north and west with limited cover for refuge may also be prevented by persecution.

It is not possible to say how many wildcats are killed each year in Scotland, but from a sample of 40 estates in central, eastern and north-eastern Scotland (the main areas for grouse and pheasant shoots) records of 274 wildcats killed were received in the Game Conservancy's vermin returns for the period 1984 - 1985 (Tapper in litt.). There must be additional mortality on the other estates not contributing to the Game Conservancy's survey, and thus the total kill for that period will exceed that figure. There is no reason to believe that these figures (1984 - 1985) are atypical; thus it is likely that this level of persecution has taken place annually.

There is little justification for continued persecution. The wildcat poses no significant threat either to agriculture or to forestry, and indeed may prove beneficial by preying on small mammals, rabbits and hares. Reports of lamb-killing are uncommon and appear to cease if the individual wildcat concerned is removed, which suggests that certain individuals specialise in such prey and are not typical of the species as a whole. While red grouse are taken by wildcats in some areas, the impact of this predation on grouse populations is negligible. In east Scotland, Corbett (1979) found that the total proportion of all game birds in the diet of wildcats was <7%. Jenkins, Watson & Miller (1964) found that the main predators of grouse in eastern Scotland were eagles and foxes on high ground and foxes and hen harriers *Circus cyaneus* on low ground; wildcats were also present on the low ground in their study area. They concluded that predation was not important in limiting numbers of breeding grouse on their study area. They further concluded that just because predators kill grouse it cannot be assumed that they automatically depress numbers of breeding birds. Edminster (1939) too, studying the effect of predation on a population of ruffed grouse *Bonasa umbellus* came to the conclusion that predator control did not produce a higher shootable population of the species in the autumn during years of high grouse abundance and was of doubtful justification in years of low abundance.

6.8 Hybridisation

Hybridisation of wildcats with domestic and feral cats poses a potentially serious long-term problem to the conservation of *F. silvestris* in Scotland (French, Corbett & Easterbee 1988). Present evidence suggests that hybrids are widespread in Scotland, but the examination of further specimens (Easterbee in litt.) indicates that some relatively pure populations may still remain. Because of the difficulties of distinguishing genuine wildcats from some hybrids, some records of wildcats reported in the survey may actually refer to hybrid animals. Care was taken to minimise such mistakes during interviews, and many gamekeepers are aware of the more obvious differences between the wildcat and hybrids. French, Corbett & Easterbee (1988) suggest that part of the apparent increase in wildcats in Scotland over the past 40 years is probably due to hybrids rather than genuine wildcats.

Hybridisation is most likely in areas with a relatively dense human population and thus numerous domestic cat population, and in areas where recolonisation is taking place. Areas on the southern and eastern fringes of the present range are, therefore, more likely to be at risk. Cats have been examined from these areas (Easterbee in litt.) and the results indicate

that hybrids are widespread. The purest remaining populations are most likely to be found in the more remote areas of the north and west, which have been continuously occupied by wildcats even during the population minimum and where human and domestic cat populations are low. Unfortunately such populations include those which have experienced population declines and are most vulnerable to continued persecution.

6.9 Conservation

6.9.1 Despite the initial rapid response to the cessation of persecution during the First World War, the spread of the wildcat in Britain has apparently slowed almost to a halt, and it still only occupies a small part of its original range. Conservation and consolidation of this expanded population is of importance on a western European scale. Conservation of this species cannot depend on animals inhabiting National Nature Reserves, which are too small in total area to protect more than a few individuals. The preparation of special wildcat reserves using the results of research to provide optimal requirements, particularly in the 'relict' area, although useful, could also only protect but a few individuals, unless extensive in area. The continuation of the wildcat population in Britain depends on its surviving and thriving in the wider countryside, outside reserves, and on education to reduce persecution. Also, we still know too little about the wildcat and more research is needed, to develop scientifically based conservation programmes for the species and to provide advice. Research requirements include studies on the problem and extent of hybridisation and on the ecology and habitat requirements of the species, with work in several regions, as well as on practical programmes such as the possibility of strengthening the population by releases. Several relevant studies have started already.

6.9.2 Hybridisation has been identified as a potentially serious threat to the genetic integrity of the wildcat in Scotland. In order to investigate this problem in more detail, three molecular techniques - DNA hybridisation, immunological distance and isoenzyme genetic distance - are currently being employed to examine the genome of putative wildcats throughout Scotland. It may subsequently prove possible to assess the extent of hybridisation and identify where the 'purest' remaining populations of wildcats are found. The techniques employed in this work may prove to be useful in the evaluation of wildcats if any relocation of animals is considered (see above).

6.9.3 Further studies are required on the ecological relationships between the wildcat and its environment in areas other than the north-east of Scotland, where Corbett (1979) carried out his work. It would also be of value to assess the use made of conifer forest by wildcats at different stages of the rotation, since this is a major and increasing form of land-use in Scotland. While Corbett (1979) has demonstrated the value of young plantations to wildcats in east Scotland, information collected in this survey indicates that older stands may not prove so attractive. This could be related to a reduction in the availability of prey populations after canopy closure and the shading out of ground vegetation. Blandford (1987) also expressed reservations about the value of older forestry plantations for the polecat *Mustela putorius*, while acknowledging the almost certain benefits to this predator in the early stages of growth. Radio-tracking studies of behaviour, range size and movements and habitat use have been started by the NCC in west Scotland in 1990, with help from the Vincent Wildlife Trust.

6.9.4 It may be appropriate to strengthen existing but isolated and fragmented populations of the wildcat in Scotland by a release programme, as has been

carried out for the otter in eastern England (Jefferies, Jessop & Mitchell-Jones 1984). However, such action would need careful planning and execution, following the lines adopted for the release of otters by Jefferies & Mitchell-Jones (1982). This would include the careful selection of a release area, the co-operation of land-users and a detailed monitoring programme to assess the response of the animals to their 'new' environment. An additional consideration would be that any animals used in such a scheme should be as close to the 'pure' form of wildcat as possible. Captive breeding programmes could ensure this and may be appropriate. 'Unofficial' releases would be irresponsible and misguided for a number of reasons. The genetic status of the animals would be unknown and thus hybrid animals could be released. If animals are released into existing wildcat range their chances of establishing a territory will be reduced, and newly released animals are likely to be more vulnerable to persecution. The behaviour and survival rate of released wildcats would be unknown.

Table 6.3

Records of the persecution of wildcats in Scotland (10 km squares in each sub-unit of the survey area)

OS 100 km grid square	% of positive 10 km squares with information	Persecution (number of squares)	No apparent persecution (number of squares)
NC	70	15	8
ND	100	7	3
NG	25	1	2
NH	50	19	12
NJ	67	25	4
NM	52	2	12
NN	35	12	8
NO	44	14	2
NR	64	3	4
NS	67	0	4
Total	*	98	59

Note Sub-units NT and NK had no records of wildcats. *An overall percentage has not been calculated.

7 Evaluation of the technique

The coverage of 499 ten km squares included all the squares on mainland Scotland with 20th century observations of wildcats up to a boundary of reported negatives - that is, it was complete. The numbers of observers (over 400) and observations (over 700) were by far the largest number used in any survey of the wildcat carried out so far. (A previous published survey by Taylor (1946) covered 111 forests; Jenkins (1962) analysed 135 returned questionnaires.) These numbers in fact make it one of the largest, if not the largest, questionnaire and interview survey carried out on any British mammal. Interviews showed that the infrequency of good observations of the wildcat made them linger in the memory of the observer; consequently they could be related to years and sometimes to exact dates. The overall field 'exposure' time available from these observers, even allowing only 40 hours of each week spent in the field, amounts to over four million hours in five years. This of course very considerably outweighs the number of hours, and thus the observations, that any full-time surveyor or surveyors could achieve within the bounds of the usual costs of mounting such projects. The results and distribution maps that were obtained fit trends observable from previous surveys of the wildcat and expand their results. There were no obvious anomalies in our results which might suggest that the techniques adopted were inappropriate for the purpose of obtaining a baseline from which to follow future changes in status. Also it has enabled a network of observers to be established, who, now that they are aware of the need, will note down further observations of the species which can be used when the survey is repeated at intervals in the future. Our conclusion is that the methodology used was valid for its purpose.

Further spread?

8

8.1 Has the wildcat reached its final limits of spread or can further colonisation be expected?

The use of the ITE land classification can be helpful in this case. We established an overall preference for land classes in Section 6.5, and, if the distribution of the preferred classes is examined, we may be able to predict which areas could be recolonised by wildcats. Within the survey area most of the apparently suitable ground now supports wildcats, and areas along the southern and south-western limits to the range may be expected to be recolonised in the near future, particularly with the substantial amounts of afforestation that are taking place.

8.2 What are the possibilities of the wildcat expanding its range south of Scotland's central industrial belt?

ITE land classification sample 1 km squares from the central industrial belt indicate the poor quality of the habitat in comparison with that found in the survey area. Out of the 16 sample 1 km squares in this area, two (one land class 18 and one land class 19) fall in the higher category, that is, preference index >0.30, while the remainder (five class 17, one class 20, one class 25, two class 26 and five class 27) all show varying degrees of avoidance, with the preference index <0.30. Thus the largest percentage of land classes from the sample 1 km squares in the central industrial belt, 87.5%, were those which were generally shown some avoidance by wildcats in the main survey area. Two of the least preferred land classes in the main study area, 17 and 26, make up 44% of the sample from the central industrial belt. Only 12.5% of the sample squares were in the higher preference category. It appears, therefore, that ground in the central industrial belt is generally unsuitable for wildcats to become established or to cross before reaching south Scotland. Coupled with the apparent unsuitability of the land is the presence of two major rivers with firths cutting far back inland and thus restricting the area in which wildcats could move to the south; the dense road network and urban and industrial development further hinder movement. It is perhaps not surprising that wildcats do not appear to have become established south of the central belt. A further factor which could hinder any possible spread of the wildcat to south Scotland is the presence of a substantial population of feral cats, both in the central belt and in the populated areas further south. Any colonising wildcats would be likely to come into contact with such animals which would result in the production of hybrid animals, if sufficient wildcats were not present with which to mate; this problem has been discussed in Section 6.8.

8.3 What are the chances of establishment if wildcats could reach south Scotland?

Again, reference to the ITE land classification can be informative. An examination of the sample of 1 km squares (n = 355) in south Scotland shows that there are 10 land classes, comprising 27% of the sample, that were not encountered in the survey area and so have not been related to use by wildcats. However, they are all lowland in nature and mostly intensively farmed or developed and, on the basis of what we found in the survey area, are therefore unsuitable for wildcats. The remaining part of the area contains 28.5% of sample squares which were preferred (preference index >0.30), and 44.5% of squares showing some avoidance. The land classes which were most avoided in the survey area comprised 13.9% of sample squares in south Scotland. There is, therefore, quite a substantial area which, theoretically, could support wildcats in south Scotland. There is also a considerable area of afforestation which could also be of benefit to the wildcat at certain stages of its development. It appears that wildcats probably could establish themselves in south Scotland, but, as, discussed above, the problems associated with the central industrial belt may well prevent this from occurring naturally.

9 Conclusions

There has been a considerable expansion in the area occupied by the wildcat population in Scotland since its minimum just before the 1914 - 18 war. This expansion occurred outwards in a 'ring' from the sub-optimal habitat of the 'relict' area, to which the wildcat had retreated through persecution during the 19th century. This expansion in distribution apparently halted around 40 years ago; since then there have been several peripheral expansions (e.g. Ardnamurchan) and several retractions or local extinctions (e.g. north-west Sutherland). This appears to be the case because most suitable ground in Scotland north of the central industrial belt has now been recolonised and further opportunities for spread are limited. There may have been increases in density in certain areas/habitats into which the wildcat has moved (e.g. Grampian Region, Section 6.5), but these are areas in which the possibility of hybridisation with feral domestic cats is at its highest. The areas where the wildcat is rare and decreasing and where local extinctions are taking place are, on the other hand, those where there is a higher percentage of true wildcats rather than hybrids. In view of the significance of hybridisation to the wildcat population, we feel that any population declines in the north-west are a matter for serious concern. Even though wildcats live at low population density, persecution has been high (Tapper in litt.) and has been reported as such up to 1988, when legal protection was afforded. Persecution in low density areas, as noted in Section 6.7.1, is a further cause for concern, because this can lead to local extinctions and prevent recolonisation.

The Scottish population of the wildcat is important not only in a national context (since Scotland is the only country in the United Kingdom with this species), but also in relation to the diminished population of western continental Europe. This report outlines the reasons for our concern for this population and why recommendations were made for the wildcat to receive full legal protection in 1988.

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11 References

ANDERSON, M.L. 1967. *A history of Scottish forestry.* Ed. by C.J. Taylor. London, Nelson.

ANDREWS, E., & CRAWFORD, A.K. 1986. *Otter survey of Wales 1984-85.* London, The Vincent Wildlife Trust.

ARNOLD, H.R., ed. 1978. *Provisional atlas of the mammals of the British Isles.* Huntingdon, Institute of Terrestrial Ecology.

ARNOLD, H.R., ed. 1984. *Distribution maps of the mammals of the British Isles.* Biological Records Centre. Huntingdon, Institute of Terrestrial Ecology.

BATTEN, H.M. 1953. *British wild animals.* London, Odhams Press Limited.

BENEFIELD, C.B., & BUNCE, R.G.H. 1982. *A preliminary visual presentation of land classes in Britain.* Grange over Sands, Institute of Terrestrial Ecology. (Merlewood Research and Development Paper No. 91.)

BERG, R.L., McDONALD, L.L., & STRICKLAND, M.D. 1983. Distribution of mountain lions in Wyoming as determined by mail questionnaire. *Wildlife Society Bulletin, 11,* 265-268.

BIGNAL, E.M., & EASTERBEE, N. 1984. The status of the wild cat in Kintyre. *The Scottish Naturalist, 1984,* 49-51.

BLANDFORD, P.R.S. 1987. Biology of the polecat *Mustela putorius:* a literature review. *Mammal Review, 17,* 155-198.

BROWN, L.H., & WATSON, A. 1964. The golden eagle in relation to its food supply. *Ibis, 106,* 78-100.

BUNCE, R.G.H. 1978. *An ecological survey of Cumbria.* Cumbria County Council and Lake District Special Planning Board, Kendal. (Working Paper No. 4.)

BUNCE, R.G.H. 1980. The application of computer aided techniques for landscape description in Britain. *In: Quantitative landscape mapping in Britain. A review of experiences in the United Kingdom, Switzerland, West Germany, the Netherlands and Norway,* ed. by S.W. Bie. Oslo, Norwegian Computing Center.

BUNCE, R.G.H., BARR, C.J., & WHITTAKER, H.A. 1981. *Land classes in Great Britain: preliminary descriptions for users of the Merlewood method of land classification.* Grange over Sands, Institute of Terrestrial Ecology. (Merlewood Research and Development Paper No. 86.)

BUNCE, R.G.H., & HEAL, O.W. 1984. Landscape evaluation and the impact of changing land-use on the rural environment: the problem and an approach. *In: Planning and ecology,* ed. by R.D. Roberts and T.M. Roberts, 164-188. London, Chapman & Hall.

CHANIN, P.R.F., & JEFFERIES, D.J. 1978. The decline of the otter *Lutra lutra L.* in Britain: an analysis of hunting records and discussion of causes. *Linnean Society. Biological Journal, 10,* 305-328.

CHAPMAN, P.J., & CHAPMAN, L.L. 1982. *Otter survey of Ireland.* London, The Vincent Wildlife Trust.

CHARLES, W.N. 1981. Abundance of field voles *(Microtus agrestis)* in conifer plantations. *In: Forest and woodland ecology,* ed. by F.T. Last and A.S. Gardiner, 135-137. Cambridge, Institute of Terrestrial Ecology. (ITE Symposium No.8.)

CORBET, G.B. 1971. Provisional distribution maps of British mammals. *Mammal Review, 1*, 95-142.

CORBETT, L.K. 1978. Current research on wildcats: why have they increased? *Scottish Wildlife, 14*, 17-21.

CORBETT, L.K. 1979. *Feeding ecology and social organisation of wildcats* (Felis silvestris) *and domestic cats* (Felis catus) *in Scotland.* Unpublished Ph.D. thesis. University of Aberdeen.

CRAWFORD, A.K., EVANS, D., JONES, A., & McNULTY, J. 1979. *Otter survey of Wales.* Lincoln, Society for the Promotion of Nature Conservation.

CRESSWELL, P., HARRIS, S., BUNCE, R.G.H., & JEFFERIES, D.J. 1989. The badger (*Meles meles*) in Britain: present status and future population changes. *Linnean Society. Biological Journal, 38*, 91-101.

DENT, G. 1935. British wild cat. Notes on status in Scotland. *Society for the Preservation of the Fauna of the Empire. Journal, 26*, 48-51.

DUNCAN, P. 1983. Determinants of the use of habitat by horses in a Mediterranean wetland. *Journal of Animal Ecology, 52*, 93-109.

EDMINSTER, F.C. 1939. The effect of predator control on ruffed grouse populations in New York. *Journal of Wildlife Management, 3*, 345-352.

FRENCH, D.D., CORBETT, L.K., & EASTERBEE, N. 1988. Morphological discriminants of Scottish wildcats *(Felis silvestris)* domestic cats *(F.catus)* and their hybrids. *Journal of Zoology, London, 214*, 235-259.

GREEN, J., & GREEN, R. 1980. *Otter survey of Scotland 1977-79.* London, The Vincent Wildlife Trust.

GREEN, J., & GREEN, R. 1981. The otter (Lutra lutra L.) in western France. *Mammal Review, 11*, 181-187.

GREEN, J., & GREEN, R. 1987. *Otter survey of Scotland 1984-85.* London, The Vincent Wildlife Trust.

HARDY, J. 1857. On the occurrence of the wild cat in Berwickshire. *History of the Berwickshire Naturalists' Club, 1850-56*, 357-359.

HARVIE-BROWN, J.H. 1882. The past and present distribution of some of the rarer animals in Scotland. *The Zoologist, 1881-82*, 1-50.

HARVIE-BROWN, J.H., & BUCKLEY, T.E. 1895. *A fauna of the Moray Basin, vol. 1.* Edinburgh, David Douglas.

HARVIE-BROWN, J.H. 1906. *A fauna of the Tay Basin and Strathmore.* Edinburgh, David Douglas.

HEWSON, R. 1967. The wild cat *(Felis silvestris)* in Banffshire. *Glasgow Naturalist, 18*, 477-482.

HIGHLAND REGIONAL COUNCIL. 1985. *HRC/ITE land classification system.* Inverness, Highland Regional Council. (Planning Department Information Paper No. 5.)

HUNTER, R.F. 1962. Hill sheep and their pasture: a study of sheep grazing in south east Scotland. *Journal of Ecology, 50*, 651-680.

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JEFFERIES, D.J., & PENDLEBURY, J.B. 1968. Population fluctuations of stoats, weasels and hedgehogs in recent years. *Journal of Zoology, 156*, 513-549. (Notes from the Mammal Society, No. 17.)

JEFFERIES, D.J., & MITCHELL-JONES, A.J. 1982. Preliminary research for a release programme for the European otter. *Otters. Journal of the Otter Trust, 1981*, 13-16.

JEFFERIES, D.J., JESSOP, R., & MITCHELL-JONES, A.J. 1984. Re-introduction of captive-bred European otters *Lutra lutra* to suitable field stations in England. *Otters. Journal of the Otter Trust, 1983*, 37-40.

JEFFERIES, D.J., MORRIS, P.A., & MULLENEUX, J.E. 1989. An enquiry into the changing status of the water vole *Arvicola terrestris* in Britain. *Mammal Review, 19*, 111-131.

JENKINS, D. 1962. The present status of the wild cat *Felis silvestris* in Scotland. *Scottish Naturalist, 70*, 126-138.

JENKINS, D., WATSON, A., & MILLER, G.R. 1964. Predation and red grouse populations. *Journal of Applied Ecology, 1*, 183-195.

KING, J.S. 1962. Report on animal bones. In: Excavations at the Maglemosian sites at Thatcham, Berkshire, England, ed. by J.Wymer. *Prehistoric Society. Proceedings, n.s., 28*, 355-361.

KIRK, J.C., & WAGSTAFFE, R. 1943. A contribution to the study of the Scottish wild cat. *North Western Naturalist, XVIII*, 271-275.

KOLB, H.H. 1977. The wild cat. *In: The handbook of British mammals*, 2nd ed., ed. by G.B.Corbet and H.N Southern, 375-382. Oxford, Blackwell Scientific Publications.

KRUUK, H. 1972. Surplus killing by carnivores. *Journal of Zoology*, 233-244.

LANGLEY, P.J.W., & YALDEN, D.W. 1977. The decline of the rarer carnivores in Great Britain during the nineteenth century. *Mammal Review, 7*, 95-116.

LENTON, E.J., CHANIN, P.R.F., & JEFFERIES, D.J. 1980. *Otter survey of England 1977-79*. London, Nature Conservancy Council.

MACDONALD, D.W., BUNCE, R.G.H., & BACON, P.J. 1981. Fox populations, habitat characterisation and rabies control. *Journal of Biogeography, 8*, 145-151.

MACKENZIE, O.H. 1921. *A hundred years in the highlands*. London, Edward Arnold & Co.

MILLER, G.S. 1912. *Catalogue of the mammals of western Europe (Europe exclusive of Russia), in the collection of the British Museum*. London, British Museum (Natural History).

MILLMAN, R. 1969. The marches of the highland estates. *Scottish Geographical Magazine, 85*, 172-181.

MILLMAN, R. 1970. The landed properties of northern Scotland. *Scottish Geographical Magazine, 86*, 186-203.

MOORE, N.W. 1957. The past and present status of the buzzard in the British Isles. *British Birds, 50*, 173-197.

NETHERSOLE-THOMPSON, D. 1951. *The greenshank*. London, Collins. (New Naturalist Series).

NORTH, S.G. 1977. *The distribution of selected mammals in S.W. Scotland*. Unpublished report to Nature Conservancy Council S.W. Scotland Region, Balloch.

POTTS. G.R. 1980. The effects of modern agriculture, nest predation and game management on the population ecology of partridges (*Perdix perdix* and *Alectoris rufa*). *Advances in Ecological Research, 11*, 1-79.

RABINOWITZ, A., ANDAU, P., & CHAI, P.P.K. 1987. The clouded leopard in Malaysian Borneo. *Oryx, 21*, 107-111.

RINTOUL, L.J., & BAXTER, E.V. 1935. *A vertebrate fauna of Forth*. Edinburgh, Oliver and Boyd.

RITCHIE, J. 1920. *The influence of man on animal life in Scotland. A study in faunal evolution*. Cambridge, Cambridge University Press.

ST. JOHN, C. 1893. *Short sketches of the wild sports and natural history of the Highlands*. London, The Field Library.

SCHAUENBERG, P. 1981. Elements d'ecologie du chat forestier d'Europe *Felis silvestris Schreber, 1777. Revue d'Ecologie, la Terre et la Vie, 35*, 3-36.

STRACHAN, R., BIRKS, J.D.S., CHANIN, P.R.F., & JEFFERIES, D.J. 1990. *Otter suvey of England 1984-1986*. Peterborough, Nature Conservancy Council.

TAPPER, S. 1977. The national game census - a review. *Game Conservancy Annual Report for 1976*, 28-35. Fordingbridge, Game Conservancy.

TAPPER, S. 1985. Rabbit numbers 1961-83. *Game Conservancy Annual Report for 1984*, 69-73. Fordingbridge, Game Conservancy.

TAYLOR, W.L. 1946. The wild cat *Felis silvestris* in Great Britain. *Journal of Animal Ecology, 15*, 130-133.

TEE, L.A., ROWE, J.J., & PEPPER, H.W. 1985. *Mammal and bird damage questionnaire*. Alice Holt. Forestry Commission. (Forestry Commission Research and Development Paper 137.)

VAN DYKE, F.G., BROCKE, R.H., & BISSONETTE, J.A. 1986. Use of track counts as indices of mountain lion presence. *Journal of Wildlife Management, 50*, 102-109.

VELANDER, K. 1983. *Pine marten survey of Scotland, England and Wales 1980-82*. London, Vincent Wildlife Trust.

WATSON, J., LANGSLOW, D.R., & RAE, S.R. 1987. The impact of land-use changes on golden eagles in the Scottish Highlands. *Nature Conservancy Council, CSD Report*, No. 720.

WIJNGAARDEN-BAKKER, L.H. Van. 1974. The animal remains from the Beaker settlement at Newgrange, Co. Meath: first report. *Royal Irish Academy. Proceedings, 74C*, 313-383.

12 Appendix: The use of land classes by wildcats

The use of land classes as determined by the preference index is considered in this section. Land classes are dealt with in the apparent order of preference as illustrated in Figure 6.5.

Land class 28 - varied lowland margins. A predominantly eastern distribution which showed the highest level of preference of all the land classes found in the survey area.

Land class 22 - margins of high mountains and moorland. Often associated with afforestation and generally preferred. Lower preference in the far north-west (NC) where high rainfall and acid rocks lead to poor quality moorlands and bog with low populations of prey. Brown & Watson (1964) mention the scarcity of prey in this area of north-west Scotland, with populations of rabbits mainly occurring in small birch woods and in the glens. Low preference also occurred in the western Grampian mountains (NN), where wildcats occur sporadically, even in afforested areas.

Land class 21 - upper valley slopes with moorland and peatland. Preference in central northern (NH) and central (NN) areas. Less preference in the north-west (NG) and far north-west (NC), and may reflect increasing exposure and oceanicity.

Land class 18 - open rugged uplands, transitional to enclosed land. Preference for this land class showed a distinct difference between north and south of the survey area: it was apparently selected in the south (NN, NO, NR, NS), and avoided in the more northerly and north-west parts (NC, ND, NG, NH, NJ, NM).

Land class 19 - enclosed uplands and mountains, often afforested. Preference in mid-western (NM) and central (NN) areas, but lower preference in the north-west coastal area (NG) and in the south (NS). The latter area may be experiencing recolonisation and the situation could change over the next few years.

Land class 29 - sheltered coasts with varied land-use. Overall the use of this land class appproximated to its availability. Preference for this coastal class occurs in the south-west, but in the north-west low preference is shown, probably reflecting the poor quality of the hinterland (in terms of prey availability) in this area.

Land class 25 - lowlands with variable land-use, mainly arable. Preference in the north of Scotland (NC, ND, NH), which is probably related to the scale and intensity of agriculture (see above), and avoided in the south and particularly in the intensively managed areas in the east of Scotland (NJ, NO).

Land class 20 - mid-valley slopes, mixture of upland and marginal lowland. It is not well represented throughout the survey area, and thus generally based on small sample sizes. Preference in the north-east (NJ), but avoided in the south-east (NO).

Land class 27 - fertile lowland margins with mixed agriculture. Generally less preferred, especially in the areas of intensive agriculture in eastern Scotland. Preference for this land class is predominantly in the north of Scotland (ND, NH) where agricultural ground is, in many areas, limited in extent and adjacent to and inter-mixed with other habitats, e.g. moorland and forestry.

Land class 24 - upper steep mountain slopes at high altitude. Generally not preferred by wildcats, although its use appears to be rather variable.

Land class 31 - cold exposed coasts with varied land-use. This has a restricted distribution on mainland Scotland, only occurring in three sub-units (NC, ND, NH). Some records of wildcats were collected in NC, but there were no records elsewhere.

Land classes 17 - marginal uplands with intermediate slopes. This land class is poorly represented in the survey area. It is avoided in all but sub-unit NJ, and even then shows low preference.

Land class 23 - high mountain summits with well drained moorlands. Generally avoided, with the main use recorded in the south-eastern part of the study area (NO), where more productive moorland ascends to higher altitudes.

Land class 32 - bleak undulating surfaces mainly covered in bogs. Also with a restricted distribution on the mainland, and only occurring in three sub-units (NC, ND, NH). A very low preference ocurred in NC, but there were no records elsewhere.

Land class 26 - fertile lowlands with intensive agriculture. Generally avoided by wildcats. Very low preference was recorded in eastern Scotland, where wildcats are sometimes found on the fringes of this land class.

Land class 30 - open coasts with low hills dominated by bogs. Restricted distribution on the mainland and generally avoided by wildcats. The only records of use came from south-west Scotland (NR), where preference for this land class was very low.

Table 12.1 Brief description of ITE land classes occurring in the survey area (from Benefield & Bunce 1982)

Land class	Description
17	Marginal uplands with rounded intermediate slopes. Mainly pastures with some rough grass and moorland.
18	Mainly open, rugged uplands, but with some areas transitional to enclosed land. Steep hillsides predominate. Mainly rough pasture and moorland.
19	Enclosed uplands and open mountains. Moderately steep and steep hillsides at medium altitudes. Mainly rough grazing and moorland, but often afforested.
20	Mid-valley slopes, with mixtures of upland and marginal lowland. Pasture, good grassland and some crops, but also rough grassland and peatland.
21	Upper valley slopes, with predominantly steep hillsides. Moorland or peatland with some rough grassland. Grazing and forestry.
22	Margins of high mountains, moorlands. Steep to moderate slopes at medium/high altitude. Mainly rough grazing and forestry.
23	High mountain summits, with well drained moorland. Often extremely steep hillsides at high altitude. Mainly moorland, peatland and mountain grassland, with some grazing.

Table 12.1 contd.

Land class	Description
24	Upper steep mountain slopes at high altitude. Mainly peatland and some mountain grassland and moorland. Limited grazing.
25	Lowlands with variable land-use, mainly arable. Mainly flat or gently rolling land at low altitude. Intensively farmed.
26	Fertile lowlands with intensive agriculture. Undulating or smooth slopes at low altitudes. Mixed lowland landscapes, often affected by urban development.
27	Fertile lowland margins with mixed agriculture. Gentle to steep slopes at medium to low altitudes. Arable, pasture and good grassland often with woodland.
28	Varied lowland margins with heterogenous land use. Mainly flat, but some gentle gradients, at medium/low altitude. Pasture, rough grazing, moorland and peatland.
29	Sheltered coasts with varied land-use. Easy slopes but some steeper areas at low or low/medium altitudes. Peatland, moorland, some bracken. Open range grazing and crofting.
30	Open coasts with low hills dominated by bogs. Open moorlands near to the sea, extending from medium/low to medium/high altitude. Open range grazing and crofting, with peatland and moorland.
31	Cold exposed coasts with varied land-use. Mainly rough grazing, but some good grassland and pasture with crofting. Moorland, peatland and rough grassland.
32	Bleak undulating surfaces mainly covered in bogs, often with scattered lochs and eroding peat hags. Mainly open range grazing, on moorlands and peatlands, but some pasture.

The Nature Conservancy Council for Scotland is a Government-funded agency which furthers the aims of nature conservation in Scotland. Responsible to the Secretary of State for Scotland, it provides advice on nature conservation to all those whose activities affect wildlife, landforms and features of geological interest throughout Scotland.

In 1992, the NCCS will merge with the Countryside Commission for Scotland to form Scottish Natural Heritage whose remit will be to protect Scotland's wildlife, culture, communities and natural resources.

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