No. 12

Lowland heathland: the extent of habitat change

L. Farrell

English Nature Science

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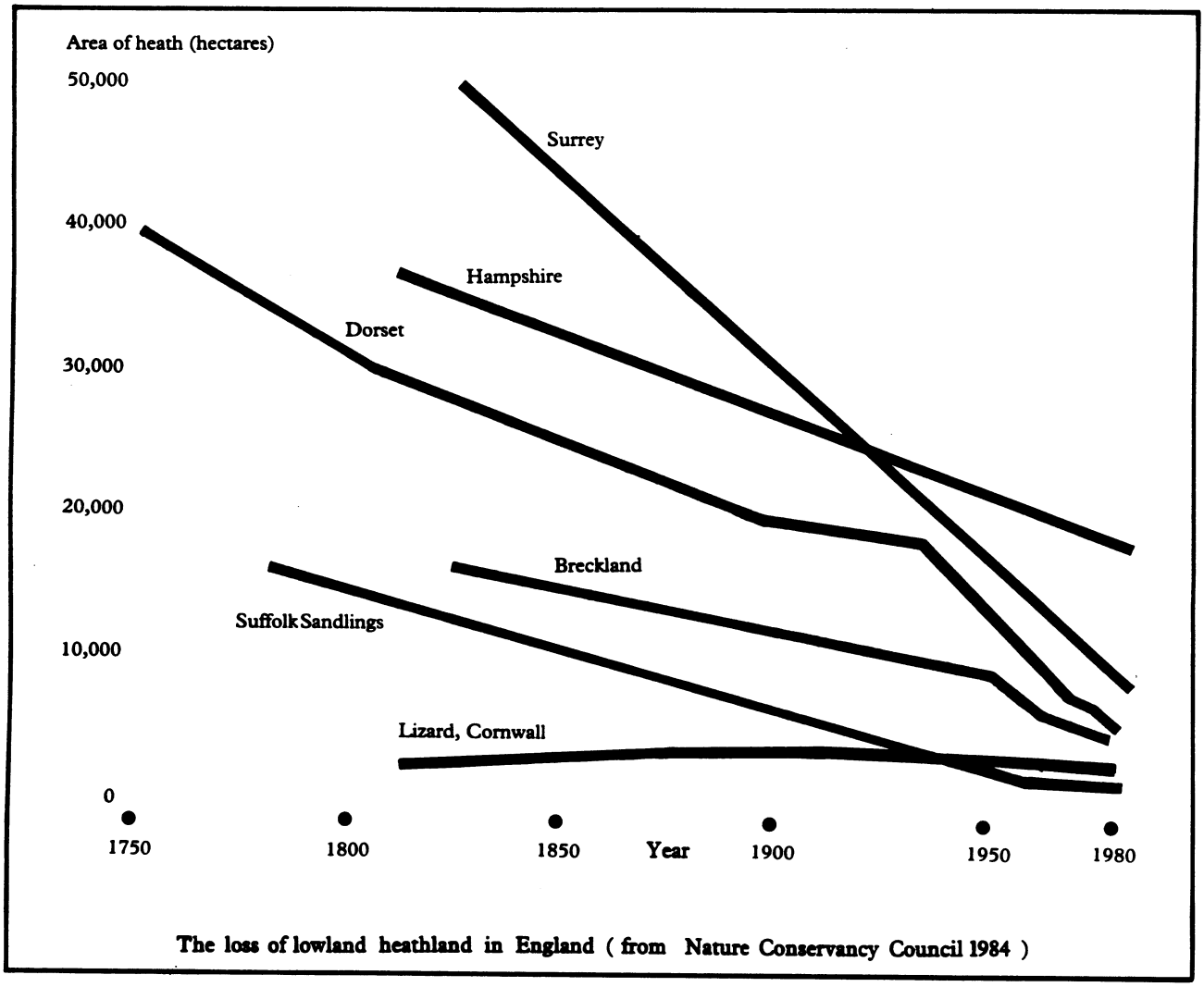
Further copies of this publication may be obtained from
Publicity and Marketing Branch, English Nature,
Northminster House, Peterborough PE1 1UA

ISBN 1 85716 087 8

FOREWORD

This report was originally written by Lynne Farrell in 1987 as part of a study by the Nature Conservancy Council into the extent of habitat change in Britain. In view of the extent of changes in the area of lowland heathland in England (see frontispiece) and growing interest in the possible re-creation of lowland heath, English Nature is publishing this report to provide data on the past extent of this habitat. This report was updated in 1992 by Dr Nick Michael, English Nature's national lowland heathland specialist wherever information was readily available.



The loss of lowland heathland in England (from Nature Conservancy Council 1984)

LOWLAND HEATHLAND : THE EXTENT OF HABITAT CHANGE

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INTRODUCTION

Strictly, heathland is vegetation dominated by dwarf shrubs, notably heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, bell heather *Erica cinerea* and bilberry *Vaccinium myrtillus*. Characteristically, heaths are found on acid, nutrient-poor soils developed on freely-drained sands and gravels, where plant growth is inhibited by low concentrations of phosphorus and nitrogen (Specht 1979). However, in more common usage, heathland means any kind of barren waste ground, especially where trees are sparse or absent and the prevailing landscape is largely bleak, bare and open. The Lincolnshire Limestone, for example, was once covered by extensive common pastures comprising alkaline grassland, but this was known as 'The Heath', and it still is, despite the face that the grasslands have long since been enclosed and ploughed. Even today we accept as 'heathland' sites which have a good deal of grassland, bog, woodland and scrub, provided that most of the area is or was covered by heather and the land is predominantly well-drained and acid.

This type of landscape is well described by the following lines from Raunkiaer (1934):

> "The warm breeze during its leisurely passage over moor and heath has become imbued with their delicious aroma. Gently and steadily it sweeps across the immense expanses, which offer it no resistance. Peace and quiet reign supreme . . ."

This report is concerned with lowland heaths, ie those below 300 m altitude. Similar vegetation in the uplands is treated as a component of moorland. There is no easy distinction between lowland grassland and heaths, for Bent-Fescue (*Agrostis-Festuca*) grassland grades into heather and often occurs intermixed with dwarf shrub heath. Likewise, many of the sites recognised here as heathland actually contain valley mires, but these are such specialised habitats that they are not discussed here.

Description and distribution

British heaths are part of the 'western Atlantic alliance' (Noirfalise & Vanesse 1976), which is distributed along the Atlantic seaboard from Norway south to Portugal and east to Germany. British heaths are now concentrated into clusters in Cornwall, Devon, Dorset, Hampshire, Surrey, Suffolk and Norfolk (Figure 1), but outlying examples occur in western Dyfed, North Wales, Cumbria, Yorkshire, Lincolnshire, Staffordshire and Shropshire. Similar heaths also occur in the eastern lowlands of Scotland, for example at the Muir of Dinnet in lower Deeside and the Sands of Forvie, Aberdeenshire. Formerly, patches of heath were probably common and widespread as part of a mosaic of habitats on commons and other pastures, and even now it is still possible to find small patches of heather amongst, for example, the beechwoods of the Chiltern Hills. Most of these patches have gone, however, and the heathlands today survive as isolated fragments of various sizes surrounded by agriculture, forestry and other land uses.

The ecology of British heathland has been described by Gimingham (1972) and Webb (1986). Heather and the other dwarf shrubs are essentially fire-tolerant species which may re-grow from the charred stumps when a heath is burned. Without periodic fires or grazing, heaths are colonised by shrubs and trees and can revert to woodland within a few decades (Gimingham, in Specht 1979, p. 379-380). On the other hand, fires may be so severe that the dwarf shrubs are killed, in which case the ground is only slowly revegetated by mosses and grasses and may cease to be heathland in the strict sense. (Gimingham, in Specht 1981, p. 25-53). Likewise, heather can be damaged by heavy grazing and trampling, in which case it may be replaced by acid grassland. On the less impoverished soils, gorse *Ulex europaeus* and bracken *Pteridium aquilinum* develop strongly, especially now that the heaths are less regularly burned and grazed. Formerly, these invasive plants were cut for bedding, potash, fertiliser and winter feed, but this practice has long since died out, and as a result there has been a tendency for both to spread (Webb 1986, p. 50-51).

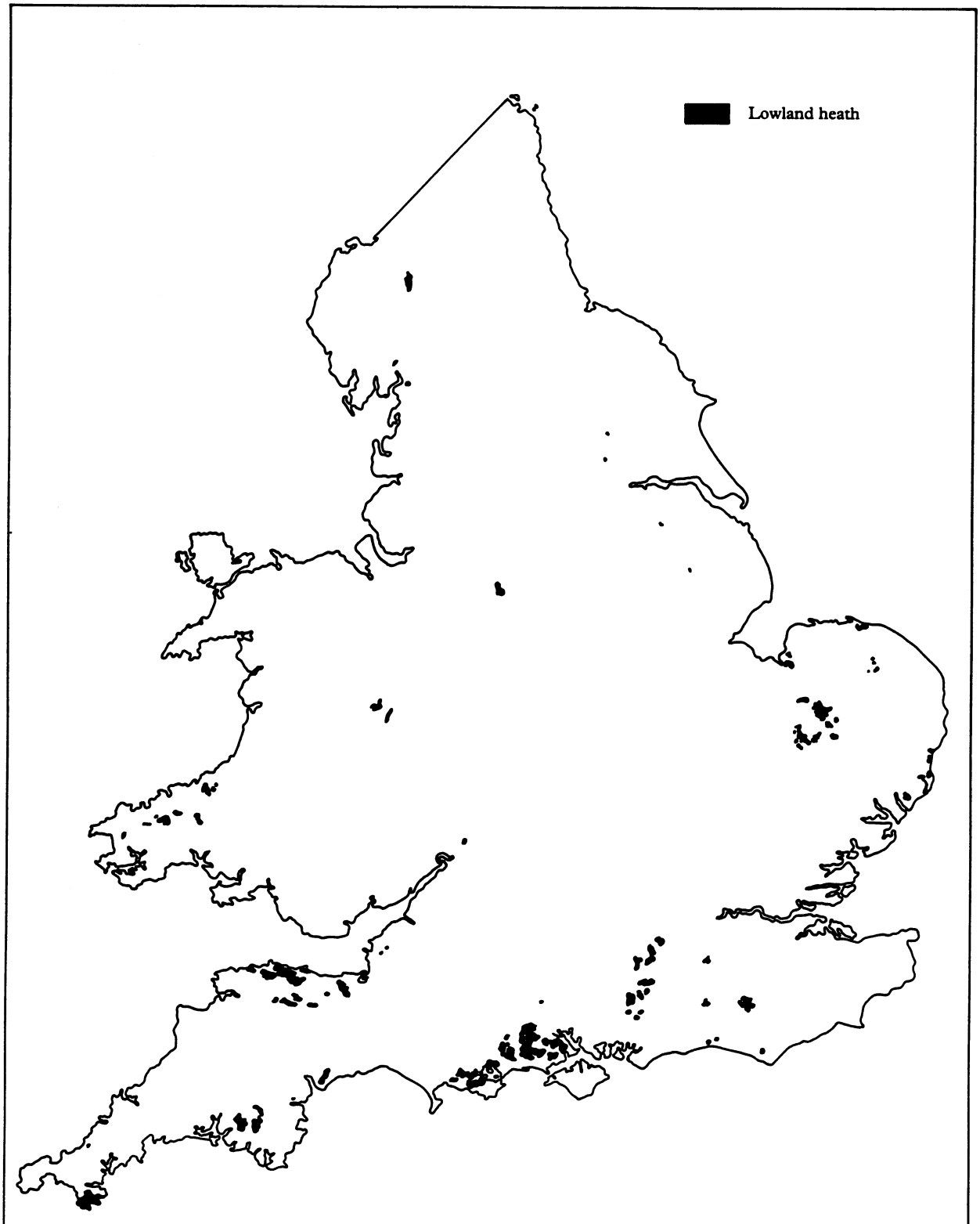


Figure 1 The distribution of lowland heath in England and Wales

British heaths are by no means uniform. Noirfalise & Vanesse (1976), in their review of European heathlands, recognised three main types - Ibero-Atlantic, Atlantic and Subatlantic - each of which is represented in some form in Britain. Within each of these types several distinct associations were recognised, based on Tansley (1939).

One of the more distinctive is the heathland of the Lizard peninsula, where the abundance of Cornish heath *Erica vagans*, a compact, lilac-flowered shrub with dense, narrow leaves, indicates the serpentine nature of the underlying soils. Low-growing species such as three clovers - twin-headed clover *Trifolium bocconei*, long-headed clover *T. incarnatum* subsp. *molineri* and upright clover *T. strictum* - and fringed rupturewort *Herniaria ciliolata* and hairy greenwood *Genista pilosa* are rarely found elsewhere in Britain, although the only species confined to the serpentine is the pigmy rush *Juncus pygmaeus* (Coombe & Frost 1956).

Whilst the Lizard heaths are the richest in botanical terms, they have very few of the characteristic heathland animals. Although all six species of reptile found in Britain occur on heathlands, the main concentrations of the rare sand lizard *Lacerta agilis* and smooth snake *Coronella austriaca* are found in Dorset and Surrey. The palmate newt *Triturus helveticus* is the most commonly occurring amphibian, but despite re-introductions the rare natterjack toad *Bufo calamita* is now restricted to only a few heathland sites, owing to the loss of this habitat.

The wetter heath and associated boggy ground with small pools are ideal territory for dragonflies, and about half the species of dragonfly that occur in Britain can be found on the southern heaths. Dry, sandy soils like those of the Breckland in East Anglia are particularly suitable for other insects, such as bees and wasps. One large black and red wasp *Ammophila sabulosa* nests only in sandy soils on heaths and dunes. Spiders are particular abundant, as the many branches of the shrubby vegetation provide ideal situations in which to suspend a web. Heathlands are not rich ornithologically, but there are several species associated with it such as the Dartford warbler *Sylvia undata*, a bird of certain southern heaths, stone curlew *Burhinus oedicnemus*, which is found on bare stony ground in the Breckland, and the nightjar *Caprimulgus europeaus*, an insect-eater often found in mature heathland where there is bracken and young, scattered birch.

Origin and history

Heathland vegetation in most parts of Britain is not natural, but has resulted from the clearance of woodland, which began during the Mesolithic period. Evidence is provided from the pollen record analysed by Dimbleby (1962) at 32 sites in Britain. Data from White Gill, Yorkshire, show the increase in grasses and other herbs and an increase of birch at the expense of alder. The presence of charcoal from oak, alder, birch and hazel together with artifacts shows that the forest was being burnt. Another site at Oakhanger, Surrey, gives evidence of a change from woodland to heathland, accompanied by progressive soil acidification.

As a result of deforestation, grazing by wild animals, such as deer, must have been intensified. Grazing by itself would not have been sufficient to bring about deforestation. The main impact on the forest would have come later in Neolithic or Bronze Age times. During the latter the forest was opened up in the highlands. The cultivation of crops apparently took place only at lower altitudes and may well have been a form of shifting cultivation (Dimbleby 1962).

Although heaths are ultimately derived from woodland, many of those we see now occupy ground which has at some time been cultivated. In periods of agricultural prosperity or high population, heaths were ploughed, fertilised and made to yield crops, but in periods of agricultural depression the land was abandoned and in due course might revert to heathland. These fluctuations took place mainly on the margins of large heath areas, but small patches of heath could form in isolation during agricultural depressions. There was a tendency for that same ground to be reclaimed whenever

agriculture expanded, and each ebb and flow has left its mark, so that modern heaths consist of a patchwork of ground, some of which has been heathland for centuries and some of which reverted to heath as recently as the 1930s. (Marrs & Proctor 1979; Clarke & Derby 1938).

Sources

Much of the early information used in estimating habitat change has come from maps, produced by organisations and individual researchers. The first edition of the Ordnance Survey around 1811 gives the definition of heathland in Dorset as "all land on appropriate soil types shown as rough and unenclosed". This is a wide definition encompassing *Calluna* and *Erica*, valley bogs, pine heath, gorse thickets, *Agrostis curtisii* and *Molinia caerulea* grasslands. A similar definition is used for Surrey where heath is defined as the "open areas on acid substrate". These terms are also used in the second edition Ordnance Survey one inch series around 1900, so direct comparisons of heathland area can be made. The second edition covering the Breckland defines heath as "rough pasture and furze". In this respect, rough pasture almost certainly represents heathland habitats, as the named heaths, commons and warrens are shown as rough pasture on the map. Furze refers to gorse, which is part of the heath.

Another source of data is the Land Use Surveys undertaken around 1930. In these, heathland is defined for Dorset and Surrey as "heath, moorland, commons and rough pasture on acid soils". Again, this embraces a wide range of vegetation types but is in line with the earlier definitions used by the Ordnance Survey and can be used to estimate change.

More recently individual researchers have tried to identify what comprises heath, and have come to similar assessments. Moore (1962), in his Dorset study, used data derived from his own field survey, in which heath is defined as "carr, gorse, scrub and acid grassland on the appropriate soil types". Webb and Haskins (1980) exclude carr and gorse, but include "dry heath with bracken and scattered scrub, humid and wet heath and peatland".

In the summary tables, showing the changes in heathland for each selected area, the definition used in calculating the figures has been included wherever possible.

As will have become clear by now, it is not easy to define 'heath' exactly. The brief technical statement "land under a thousand feet dominated by dwarf ericoid shrubs" does not really convey the composite nature of this habitat. Species such as bracken, gorse, willow, birch and pine all contribute to what we understand as heathland today. Areas of bog, mire, acid grassland, open water and scrub may well be an integral part of the habitat, even though they can be, in themselves, separate habitats. However, it is usually possible to distinguish discrete areas which convey the 'barren waste' concept, and it is the changes in these that represent the fluctuating fortunes of the heaths.

A field survey conducted by Hicks (1986) in Surrey applied what appears to be a much stricter definition viz "areas with a minimum of 5-10% heather". However, since much of the area could be covered by gorse, bracken and scrub, this too is a wide ranging definition.

CHANGES IN THE MAIN HEATHLAND DISTRICTS

Breckland

Breckland, which is centred on Thetford, Norfolk, contains about 4,500 ha of heathland. These heaths are characteristically open and grassy, with scattered gorse bushes and bracken, separated by rows of pine trees and blocks of conifer plantations. The soils are a mixture of sands, chalky glacial tills overlying chalk, and locally some gravel and loess, all with a wide range of pH from 3.7 to 8.2 (Watt 1940). This variation in soil is reflected in a range of heathland and grassland types (Watt 1940). Breckland is generally flat or gently undulating. Its climate is the most continental in Britain, with

an annual rainfall of 600 mm and high summer temperatures and sunshine hours (Clarke 1937; Chadwick 1982; Watt 1936 (Tables 1-3)). Snow never lies long, but frosts can occur in any month.

Butcher (1941) described the pattern of land-use which gave Breckland its name:

> "At the best yield of the land is poor, and when under cultivation, it soon becomes exhausted of humus and calcium. It is usual therefore to cultivate much of the medium and poor lands for a few years and then allow them to lie fallow until sufficient grassy turf has been formed to plough them up again. It is these fields which when first broken by the plough are called brakes or brecks and which because of their frequency have earned the title of Breckland for this region."

The bleak character of traditional Breckland is conveyed by Gilpin (1807) following a tour that he undertook in 1769:

> "Nothing was to be seen on either side [of the Brandon-Mildenhall road] but sand and scattered gravel, without the least vegetation; a mere African desert. In some places this sandy waste occupied the whole scope of the eye: in other places at a distance we could see a skirting of green with a few straggling bushes which, being surrounded by sand, appeared like a stretch of lowland shooting into the sea . . . In many places we saw the sand even driven into ridges and the road totally covered. It was a little surprising to find such a piece of absolute desert almost in the heart of England."

Gilpin's description belies the long history of man's occupation and modification of Breckland. Lakenheath Warren was used for rearing rabbits from the 13th century until 1940. Sheep have grazed in the Breckland since the 16th century. Partridge have been reared since the 19th century and, more recently, forestry and military training have impinged on the scene (Crompton & Sheail 1975). All these uses have brought about ecological changes.

For example, sheep were important farm animals from Neolithic times onwards (Crompton & Sheail 1975). Their densities may have risen from 1 per ha in the early medieval period (Postgate 1962) to 2 per ha by the 13th century, when about 2,200 animals grazed Lakenheath Warren. By the 17th century sheep were to be found throughout Breckland. There was then a general decline in numbers beginning in the late 17th century and continuing throughout the 18th century. Drainage improvements took place and pasture was converted into arable. A population decline in the 1920s brought about a slump in wool and mutton prices and a further decrease in the number of sheep. By the late 1940s only 600 sheep grazed the Warren and by 1956 there were none. It has been suggested that selective sheep grazing modifies the distribution of lichens. Sheep tend to congregate in certain areas and disturb the lichen cover, creating bare patches of ground into which annual plant species such as common whitlow grass *Erophila verna*, shepherd's cress *Teesdalia nudicaulis* and rue-leaved saxifrage *Saxifraga tridactylites* can spread. These bare patches may also have been enlarged by wind, rain and frost, leading to the formation of blow-outs and sand dunes. The first reference to a sand-blow relates to Thetford in the 11th century and a further one occurred at West Stow in the 13th century. At Lakenheath Warren a massive blow took place in the 17th century and was recorded as a great sand flood that engulfed the village of Santon Downham.

As the sheep created a more open, closely-cropped turf, this would have been very suitable for rabbits. During the depression, when no resources were available for new cash crops, farmers increased the number of rabbits. Rabbit numbers crashed after the outbreak of myxomatosis in 1954. Watt (1960) studied the effect of rabbit grazing on Lakenheath Warren and showed that Sheep's fescue *Festuca ovina* became the dominant species on acidiphilous grasslands when rabbits were removed. The tussocks of this grass spread and ultimately eliminated the lichens.

TABLE 1 **Temperature data for Valencia, Cambridge and Berlin: the mean annual, the mean monthly (for East Anglia as well) and the monthly extremes in °C** (from Watt 1936)

		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean annual temperature
Monthly means														
Valencia		6.9	6.9	7.2	9.0	11.2	13.7	14.9	15.0	13.7	10.9	8.5	7.5	10.45
Cambridge		3.1	3.9	5.4	8.2	11.6	14.7	16.6	16.2	13.9	9.7	6.2	3.9	9.45
Berlin		-0.7	0.5	3.2	7.6	13.2	16.7	18.0	17.0	13.8	8.8	3.8	0.7	8.55
East Anglia		3.3	3.8	5.1	7.6	10.7	13.9	15.8	15.6	13.4	9.8	6.4	4.2	9.1
Monthly extremes														**Annual range**
Valencia:	Max	11.7	12.2	13.3	16.1	20.0	22.2	21.7	21.7	20.6	16.7	13.9	12.8	10.5
	Min	-1.7	-1.1	-0.6	1.1	3.3	6.1	7.8	7.8	5.6	1.7	0.0	-1.1	9.5
Cambridge:	Max	12.2	13.3	17.2	20.6	23.9	27.2	28.8	28.3	25.6	20.0	15.0	12.8	16.6
	Min	-6.7	-6.1	-5.0	-3.3	-1.1	3.3	6.1	5.6	2.2	-1.7	-4.4	-6.1	12.8
Berlin:	Max	8.1	9.6	15.8	21.0	29.0	31.1	31.6	29.7	26.3	19.8	12.2	8.9	23.5
	Min	-11.9	-8.9	-5.9	-0.8	3.1	7.7	10.1	9.3	5.5	-0.1	-4.7	-8.7	22.0

TABLE 2 **Mean daily number of hours of sunshine for Valencia, Cambridge, Berlin and East Anglia** (from Watt 1936)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	YEAR
Valencia	1.55	2.45	3.97	5.33	6.55	6.27	5.13	5.00	4.43	3.26	2.17	1.32	3.96
Cambridge	1.71	2.66	3.90	5.33	6.52	6.70	6.52	6.06	5.03	3.35	2.07	1.20	4.29
Berlin	1.3	2.2	3.3	5.6	7.4	8.2	7.4	6.9	4.8	3.1	1.7	1.1	4.42
East Anglia	1.70	2.66	3.87	5.55	6.65	6.86	6.58	6.05	5.15	3.33	2.12	1.33	4.32

TABLE 3 **Annual and monthly rainfall in mm for Valencia, Cambridge, Berlin, Bury St Edmunds, Swaffham and East Anglia** (from Watt 1936)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Valencia	139	132	115	93	81	81	96	122	105	142	139	169	1414
Cambridge	38	32	37	34	45	54	55	60	41	60	49	49	554
Berlin	48	34	38	42	49	55	76	56	51	39	38	52	578
Bury St Edmunds	46	38	48	39	46	53	64	66	51	69	58	61	639
Swaffham	47	40	45	38	44	54	65	66	54	73	62	61	619
East Anglia	46	39	43	38	46	51	59	56	48	67	59	58	610

Military activity on the Warren also increased bare ground and there are many self-sown pines around the old gun emplacements. Bombing scattered chalk over the ground, resulting in the spread of such lime-loving species as fairy flax *Linum catharticum* and purple milk-vetch *Astragalus danicus*.

Since 1900 the extent of Breck heaths has greatly diminished (Table 4, Figures 2-6), mainly owing to agriculture and afforestation. Between 1900 and 1980, 11,758 ha were afforested or became woodland through natural succession. An even greater area was converted to arable, principally during and after the Second World War. The Elveden Estate, at 4,050 ha the largest farm in the district, converted 1,215 ha of heathland into arable between 1927 and 1952 (Martelli 1964). Changes have taken place in well-defined phases. Before 1920 heathland increased as agricultural labour was drained by the First World War and agriculture was in decline. From 1920 to 1940 the main losses were due to afforestation, as Breckland became the most productive property of the Forestry Commission. From 1940 to 1970 the main losses were due to agriculture, though forestry continued to expand. Recently, forestry has ceased to expand, but more heaths have been claimed for agriculture, and land has gone to military use and urban expansion. If it had not been for the substantial heaths retained for military training (1,076 ha) and the numerous nature reserves (671 ha), the heathland would by now almost have vanished.

The Suffolk Sandlings

The Suffolk Sandlings or Sandlands are terms used to describe heathlands in the area south-east of a line drawn from Ipswich to Great Yarmouth. They are underlain by glacial sands and gravels and were once extensive.

Travellers in the 18th century describe the area thus:

> "The sandland may be divided into the marsh, arable and heathlands. The marshland is naturally fruitful, fatting great numbers of oxen and sheep; and sometimes, when ploughed affords the greatest crops of corn of any other land in the country. The part which is arable is in some places good for tillage and produces excellent crops of all sorts of corn, and where it is in a manner barren, it is found fit for improvement by chalk rubbish, and a late discovered cragg or shell. . . The heathy part may contain about one third of the sandlands and is used for sheep walks." (Kirby 1753)

In 1771, Young described the Woodbridge region as having:

> "Unquestionably one of the driest climates in the Kingdom. The frosts are severe and the north east winds sharp and prevalent. There is a large amount of poor and even blowing sand to be found . . . The whole of the maritime region may be termed sandy."

The history of their decline is very similar to that of Breckland - the decrease in the importance of sheep-folding and rabbit warrens combined with an increase in afforestation, arable farming, recreational activities and urban development. Sheep grazing per 100 acres of crops, grass and rough pasture in 24 parishes fell from 42.8 in 1938 to 12.1 in 1962 (Armstrong 1971). Summer irrigation, first used by a Suffolk farmer in 1947, allowed the production of better crops on the light, sandy soil in a low-rainfall area.

Urban development, especially around Ipswich, has accounted for a significant loss (Figure 7), leaving only two areas of any reasonable size, Purdis Farm and Martlesham.

TABLE 4 Extent of Breckland Heaths, 1900-1980

Year	Source of information	Heathland area (ha)	New heathland (ha)	Heathland lost (ha)	Main changes
1900	OS 1:63360 2nd Edition	28,932	+10,862	-7,872	World War One reversion of arable to heath; losses: 546 ha to arable, 7,326 ha to afforestation
1934	Land Utilization Survey, 1934-35. (L D Stamp)	31,922	+585	-23,239	Arable expansion during and following the Second World War.
1950	Base OS 6" map and air photos from RAF (1946) showing areas of rough grazing not on peat <50% scrub cover	9,268	+260	-3,555	Considerable losses to forestry (4,432 ha between 1934 & 1967) and further losses to agriculture
1963	OS 6" to 1 mile 3rd Edition	5,973	+220	-1,664	
1980	NCC survey (1980) - G Radley - including heather and grass heath	4,529			590 ha lost to military and urban use

Figure 2 Area of heathland in Breckland in 1900

Figure 3 Area of heathland in Breckland in 1934 (from First Land Utilisation Survey)

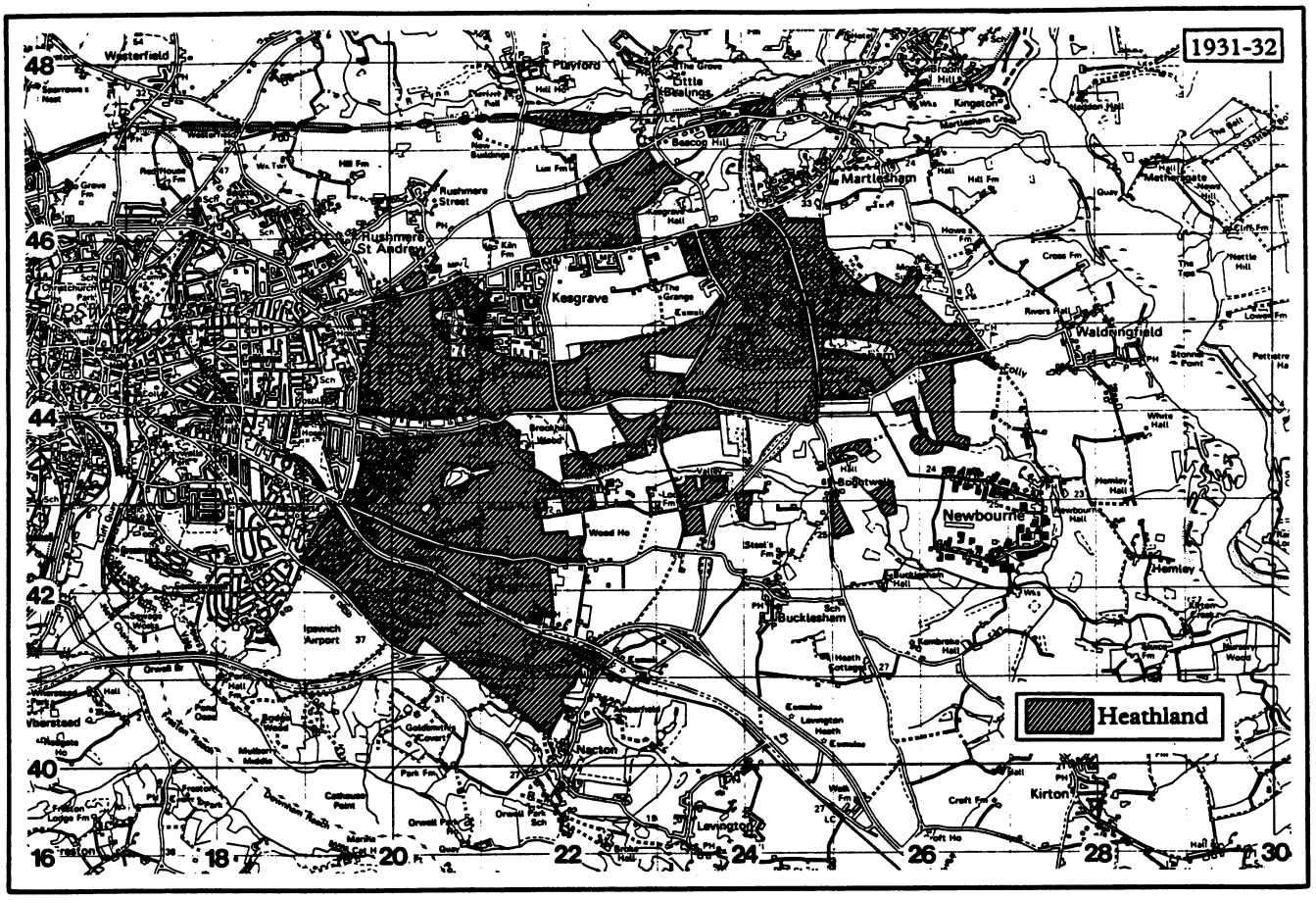
Figure 4 Area of heathland in Breckland in 1950

Prepared by Geographic Information Unit, English Nature, Peterborough.

Figure 5 Area of heathland in Breckland in 1963

Figure 6 Area of heathland in Breckland in 1980
(from Nature Conservancy Council survey 1980, unpublished)

Prepared by Geographic Information Unit, English Nature, Peterborough.



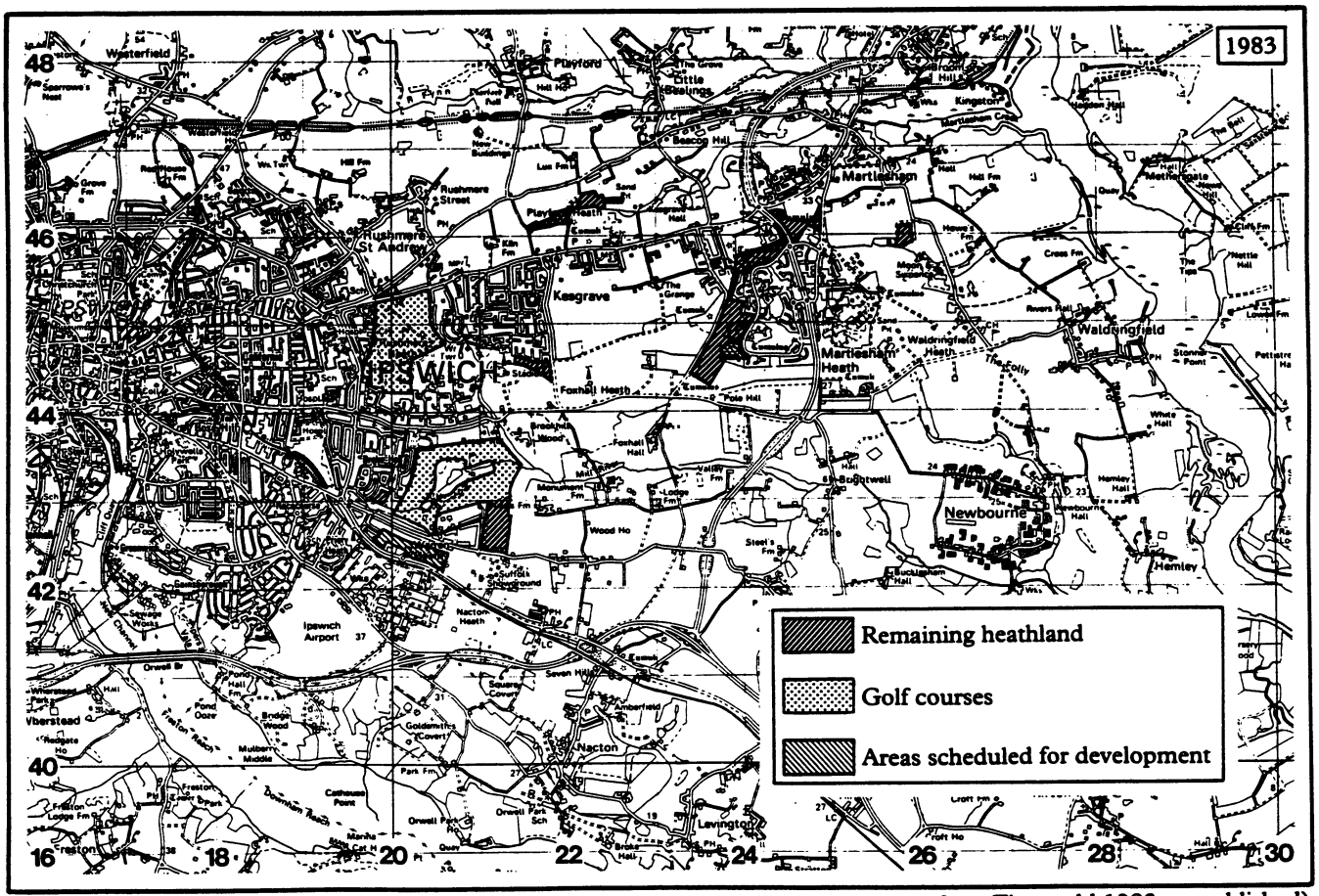


Figure 7 Change in the extent of heathland around Ipswich between 1931-32 and 1983 (from Fitzgerald 1983, unpublished)

The Sandlings are relatively flat, with few places above 20 m in height, and are therefore eminently suitable for use as air strips. Several hundred acres were acquired for Martlesham airfield before the Second World War, but this has since been disposed of to a property company (Armstrong 1971). RAF Woodbridge and Brentwater were established on heathland, plantation and farmland. It is estimated that 405 ha of heath are now within air bases. Access to these areas is restricted and the vegetation is frequently cut, but they can act as refuges for heathland species. The type of heathland within may have changed from a heathery turf to a grass-dominated community, but the habitat has only been modified and not lost.

Modification of the heath has also taken place during the construction and maintenance of golf courses. Habitats range from woodland to smooth lawns on the courses, with many of the 'roughs' being remnant heathland. About 506 ha of heath have been converted to golf links (Armstrong 1971). The main construction periods coincided with the times of agricultural depression in the 1880s, 1890s and 1920s. Aldeburgh and Southwold was built in 1884, Purdis Heath, Ipswich, 1895 and Rushmere Heath, Ipswich, 1927 (Armstrong 1975).

In 1925 the Forestry Commission was set up and their main planting effort in this area took place over the next 15 years. By 1930, 1,538 ha were afforested and 2,317 ha by 1940 (Armstrong 1971). There was a respite during the Second World War and then another planting phase began about 1950. By 1968 there were 3,502 ha under conifers.

As in Breckland, the outbreak of myxomatosis in 1954 devastated the rabbit population. On one estate 5,025 animals are recorded as being killed during the 1953/54 season, but only 35 during the following year (Armstrong 1975). This is reflected in the very low number of stoats, which prey on rabbits, recorded. As a result, the number of ground-nesting birds, such as the wheatear, increased during 1954 and 1955.

Myxomatosis has had an indirect effect on the population of heathland insects. With the reduction in rabbit grazing the cat's tail grass *Phleum nodosum*, food plant of the small skipper *Thymelicus sylvestris* and Essex skipper *T. lineola* butterfly larvae, grew vigorously. Now, the open, grassy areas have been invaded by scrub in many places. The silver-studded blue *Plebejus argus*, which lays eggs in short heathland, was recorded as common on the east Suffolk heaths in 1952, but has now been lost from several sites (Mendel & Piotrowski 1986). The decline of the rabbit also led to an increase in the number of tree seedlings surviving, and many of the areas which were open heath in the 1950s are now being rapidly colonised by pine and birch. The nightjar *Caprimulgus europaeus* prefers to nest near or under a sheltering tree in a small clearing where the heather is 20-60 cm deep (Berry 1979). Its optimum habitat is therefore in an area where birch scrub is expanding across open heathland, or within heather glades in birch scrub. Dense birch or pinewoods are, however, avoided. Deliberate management at the Minsmere RSPB reserve has increased the population of nightjars from five churring males in 1982 to 23 in 1988 (Burgess, Evans & Sorensen 1989).

By 1983, 1,580 of the 16,403 ha of heathland occurring in 1783 in the Sandlings were left, a loss of 90% (Table 5, Figures 8-12). Most of the remaining areas are now in nature reserves. These areas are deteriorating as heathland habitat because of neglect and lack of grazing. The Suffolk Sandlings Project found that of the 1,800 ha of remaining heathland, bracken and scrub covered 62% of the area (Fitzgerald *et al.* 1987). The Sandlings Project has combatted this problem by bracken swiping and using selective herbicides as well as the re-introduction of sheep grazing (Fitzgerald *et al.* 1991).

TABLE 5 Estimate of the changing extent of heathland on the Suffolk Sandlings

Date	Area in hectares	Rate of decline	Source of information	Cause of loss
1783	16,470		Joseph Hodgkinson's map of Suffolk - 1½ inches to 1 mile (Chadwick 1982)	
1880	13,300	19%	1st Edition OS maps, 6 inches to 1 mile (Fitzgerald)	(Some agricultural land reverted to heath between 1880 and 1930)
1931-32	9,330	30%	1st Land Utilization Survey (L D Stamp) 1931-32 (Chadwick 1982)	Reduction in grazing (sheep) and conversion to arable with irrigation developments.
1965	2,600	72%	Chadwick 1982	Urban expansion round Ipswich. Golf course building. Afforestation (3,502 ha planted between 1930-68)
1983	1,580	39%	Sandlings Group: Suffolk Trust for Nature Conservation, unpublished data (Fitzgerald 1983)	Continuing deterioration due to lack of grazing, resulting in invasion by bracken and woodland

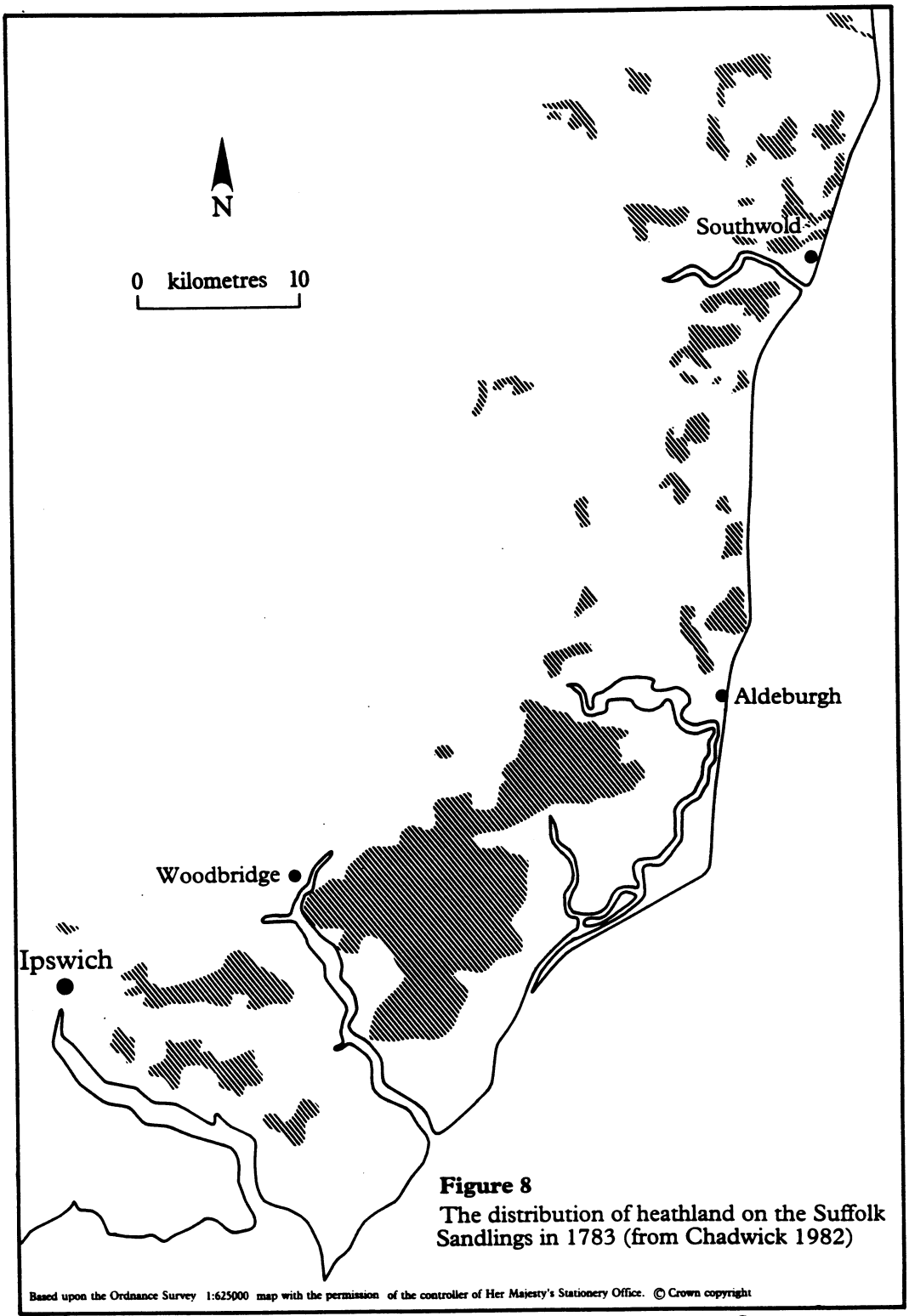


Figure 8
The distribution of heathland on the Suffolk Sandlings in 1783 (from Chadwick 1982)

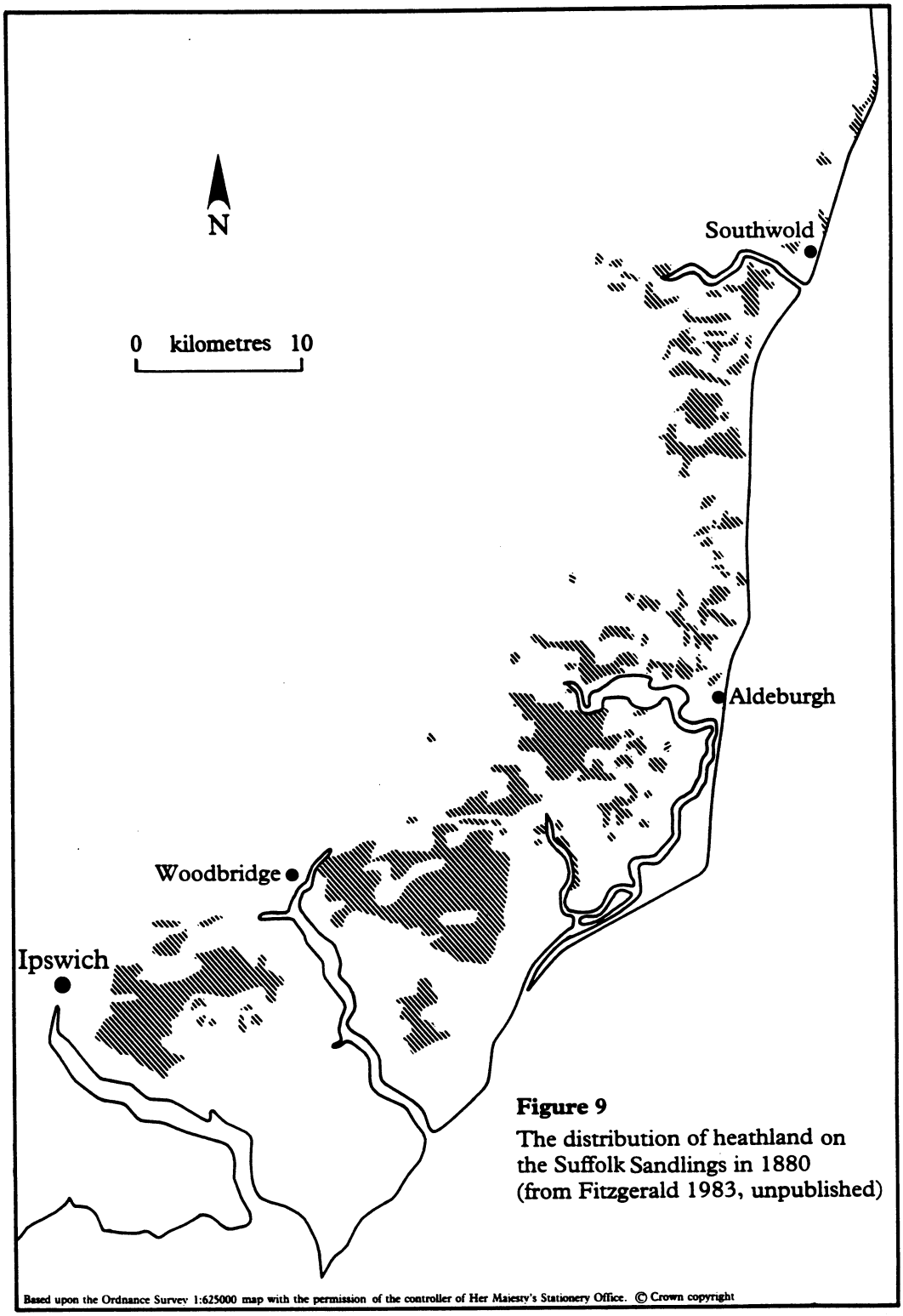


Figure 9
The distribution of heathland on the Suffolk Sandlings in 1880 (from Fitzgerald 1983, unpublished)

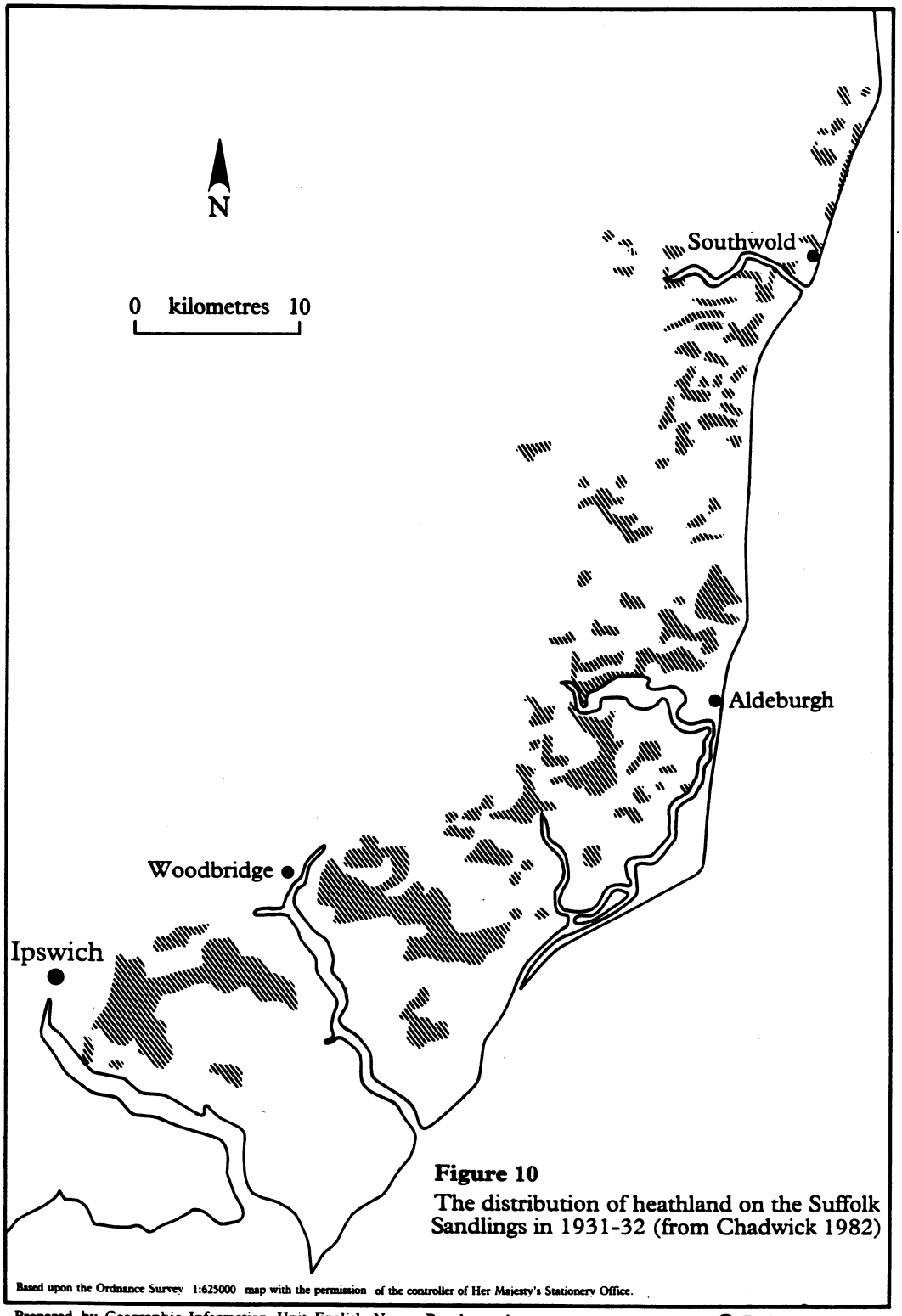


Figure 10
The distribution of heathland on the Suffolk Sandlings in 1931-32 (from Chadwick 1982)

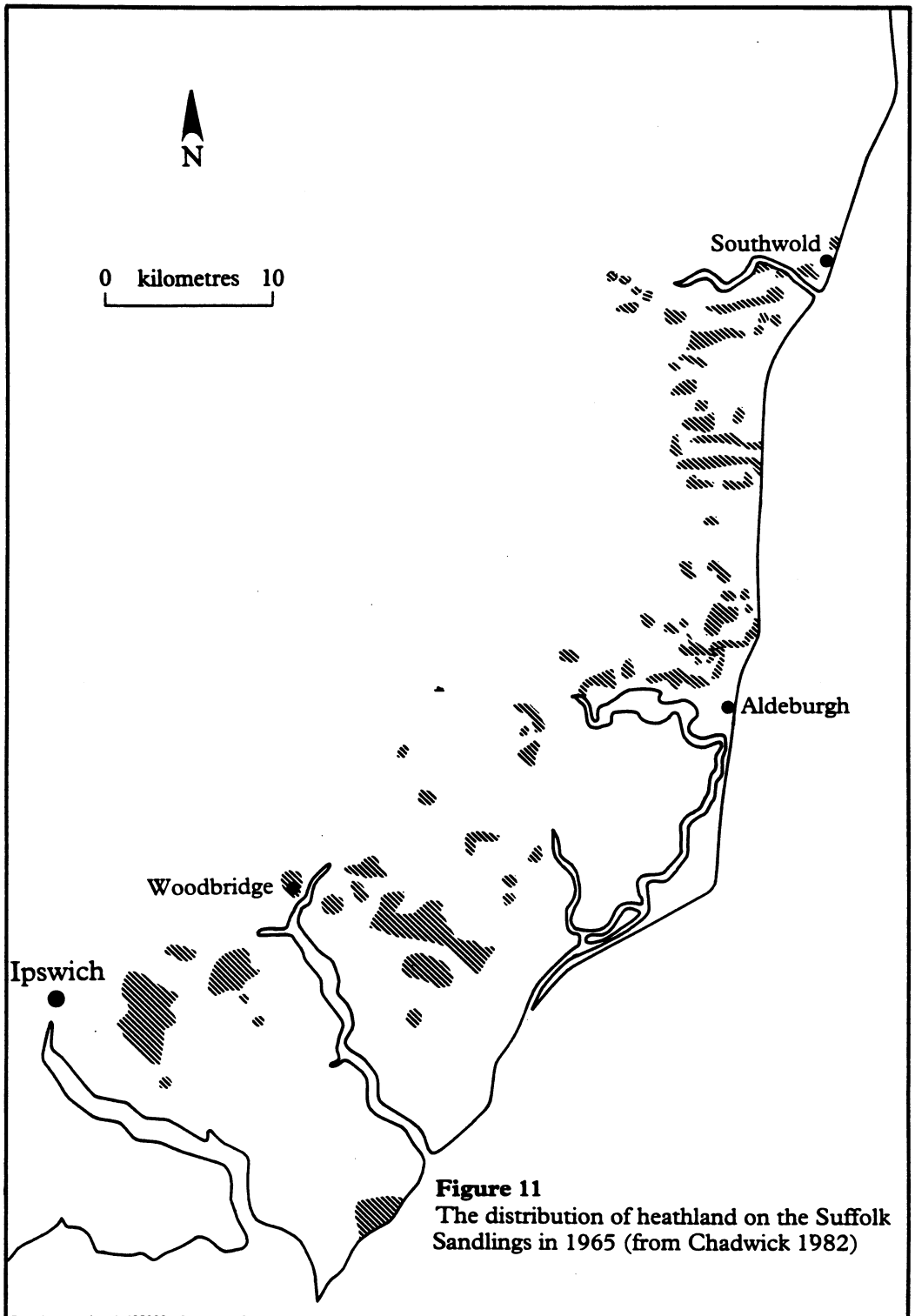


Figure 11
The distribution of heathland on the Suffolk Sandlings in 1965 (from Chadwick 1982)

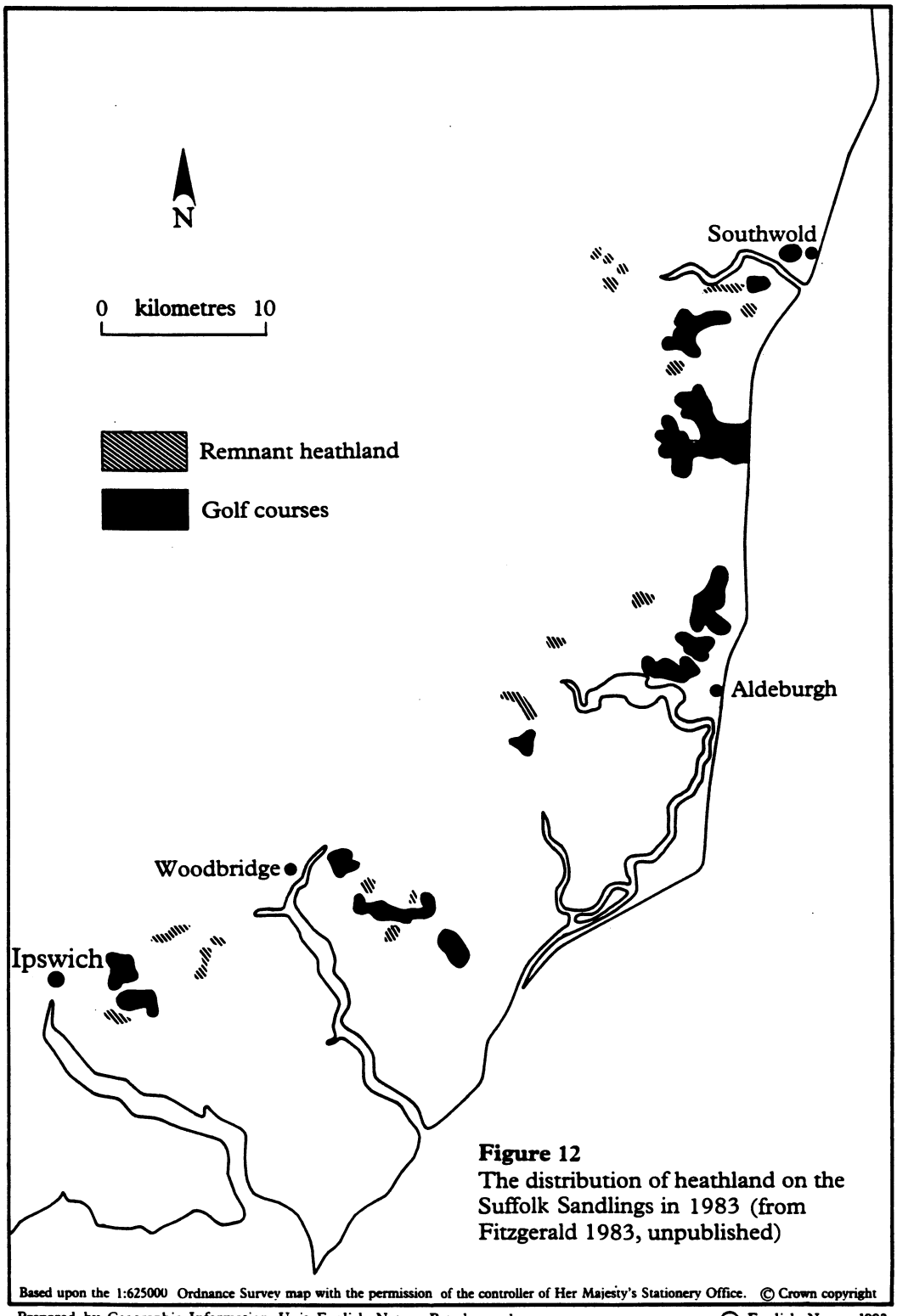


Figure 12
The distribution of heathland on the Suffolk Sandlings in 1983 (from Fitzgerald 1983, unpublished)

The Surrey heaths

The Surrey heaths occur on the Weald of south-east England and are associated with sandy parent materials, ranging from the Bagshot sands in the north and west of the county to the Hythe series and Lower Greensand formation further south. There are also some heaths associated with soils developed on Pleistocene sands and gravels (Harrison 1976). Geographically, they extend from the western part of the county of Surrey to adjoining areas in east Berkshire, north-east Hampshire and north-west Sussex. This wider area of heathland has been called 'The Surrey Heaths' by Tamarind (1975) and Hicks (1986). However, a recent study by Hale (pers. comm.) gives more detailed documentation for the loss of heaths within the administrative county of Surrey since 1762, and this narrower definition of Surrey heaths is used here.

Hale's study shows the net changes in heathland extent since 1762 (Figures 13-16). The maps from which these values are derived use a variety of heathland definitions but all involve open land on an acid substrate. These definitions are summarised in Table 6. Between 1762 and 1863 there was very little change in the overall extent; however during the period 1863-1931 fragmentation took place. Since then scrub and woodland has gradually encroached resulting in the decline of open heath. This was mainly caused by the cessation of grazing and the planting of pines.

Pine was first introduced into Surrey around 1830. The commons were still mainly open heath until the mid-19th century. Pine then spread from the plantations to the north and west and by 1910 the whole of Esher and much of Oxshott Commons were covered by pine (Stubbs 1979). Extensive felling for pit props took place on Esher in 1917 (Summerhayes, Cole & Williams 1924). A study of the stages of recolonisation over the next seven years (Summerhayes, Cole & Williams 1924) illustrates what must have taken place over many of the Surrey heaths. In 1920 six types of original heathland communities were described. These are heather, bracken, grass heath, gorse and bramble scrub, pure *Molinia* and a mixed *Molinia*/heath community. The woodland was restricted in area at this stage, but already there were pine seedlings spreading out over the open heath. This was partly checked by pulling up the young trees. The abundance of the fungi *Polyporus schweinitzii* and *Formes annosus*, which kill pines, also restricted the pine invasion. The mixed woodland, mainly birch, ash and oak, was limited in extent. The grass heath community, instead of being maintained by rabbits as in the Breckland, was seen to develop on small stretches near roads, where there was much trampling by humans. In 1921 the succession was halted by extensive fires, but by 1925 the dry heath had been invaded by bracken, young birch trees were found everywhere and rose-bay willowherb *Chamaenerion angustifolium* had established itself, particularly on the burnt areas. In the dry areas the bare, stony soil was not favourable for the establishment of pine seedlings, whilst in the wetter areas, particularly amongst the *Molinia* and in the birch scrub, young pines were abundant (Summerhayes & Williams 1926).

In the 1950s the rate of colonisation by pine and birch was remarkably rapid (Stubbs 1979). Planting in the mid-1960s accelerated the process and by 1966 most of Esher Common was conifer woodland with birch. A field survey carried out in 1985 (Hicks 1986) describes Esher Common. "Only a few remnant strips of mainly dry heath remain, mainly along rides, occasionally surviving below a pine canopy elsewhere. One large block remains of good heather which appears to have been recently cleared of pine. One patch south of the A3 has 100% cover of scrub, but just enough heather remains to map." The situation was worse at Oxshott Heath. "Practically all pinewood; one small area of dry heath does exist on an exposed slope. This remains quite open but is suffering from erosion. Satellite blocks are subject to varying degrees of scrub invasion."

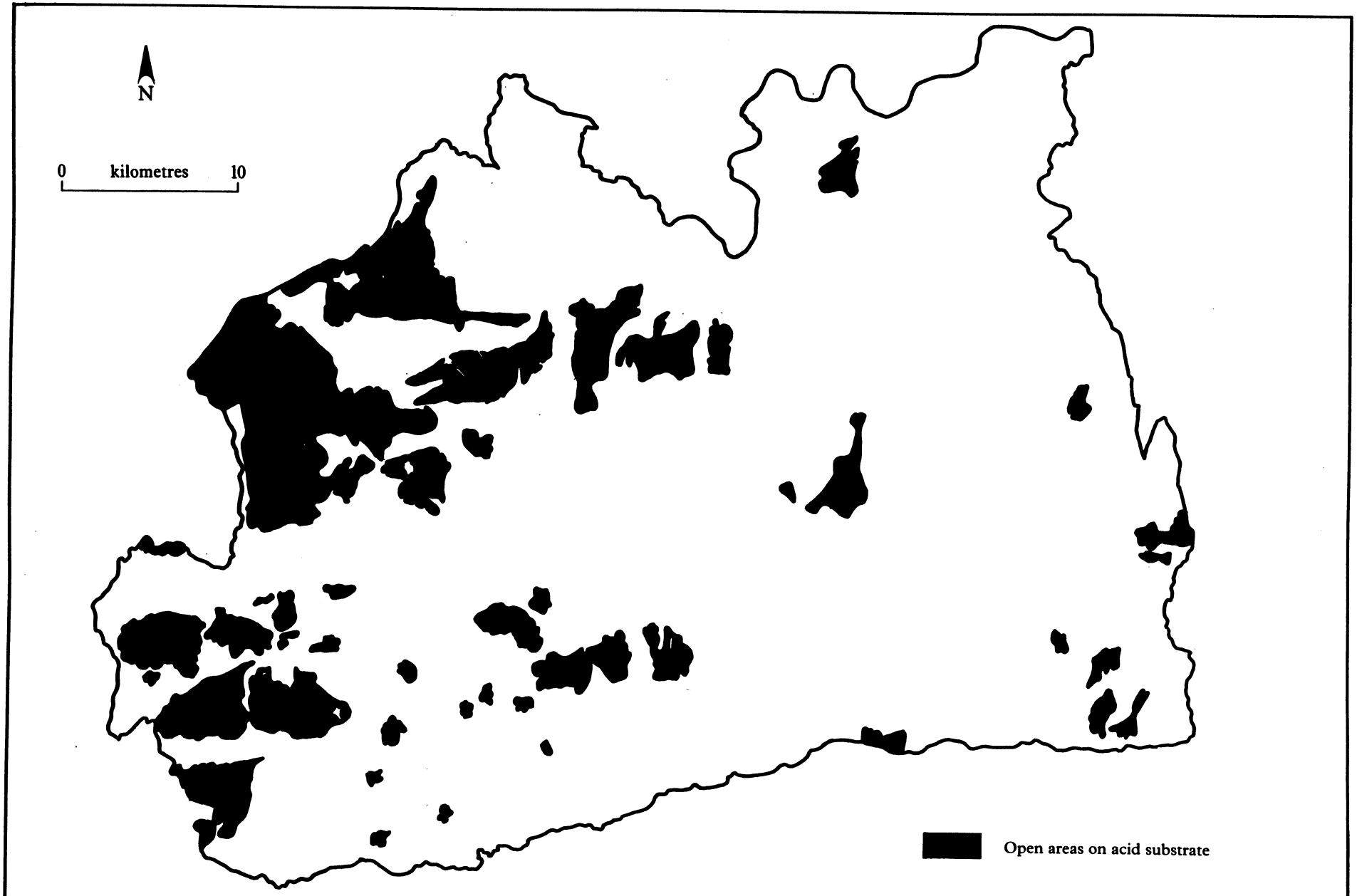


Figure 13 Distribution of heathland in Surrey in 1762 (from Hale 1984, unpublished)

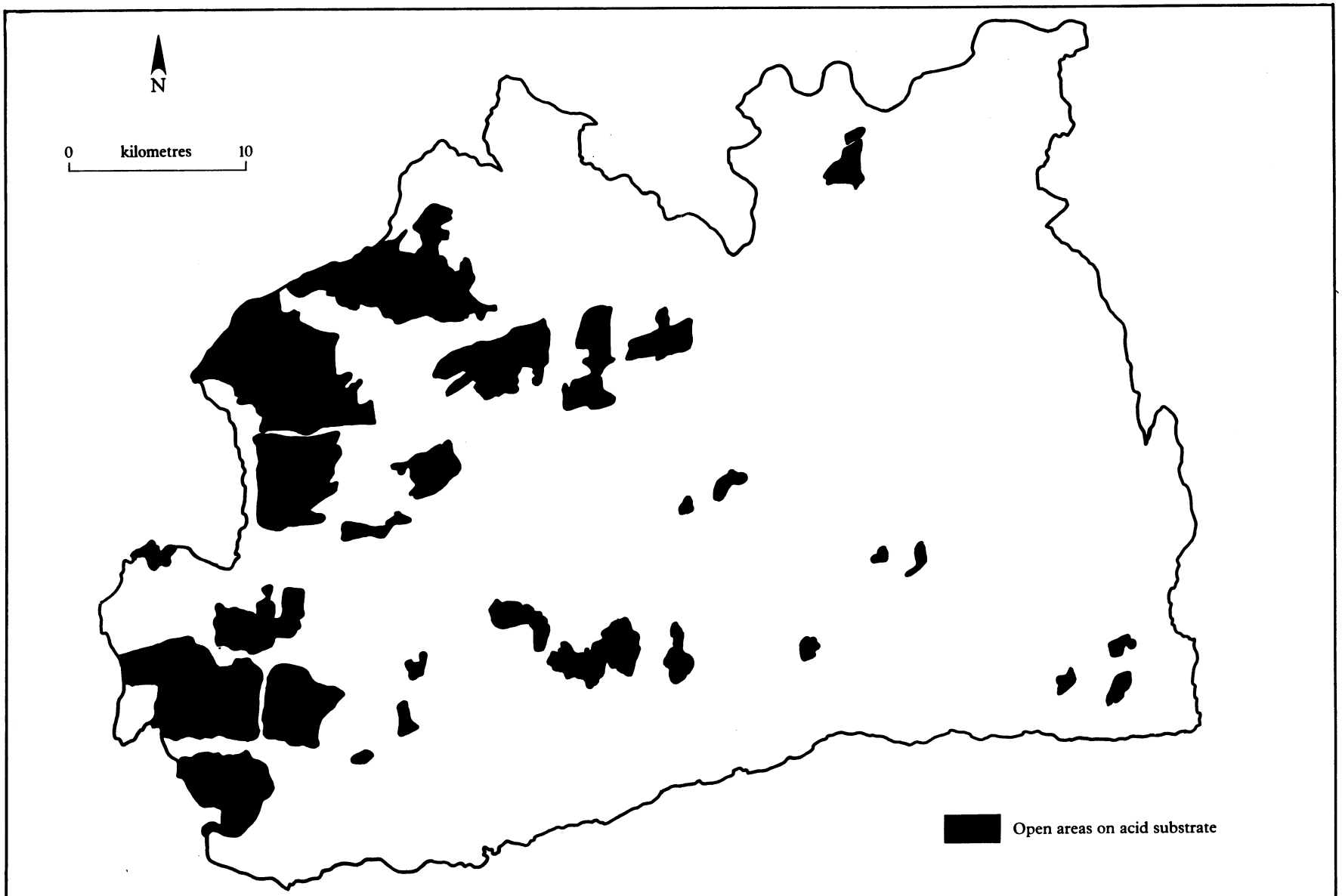


Figure 14 Distribution of heathland in Surrey in 1863 (from Hale 1984, unpublished)

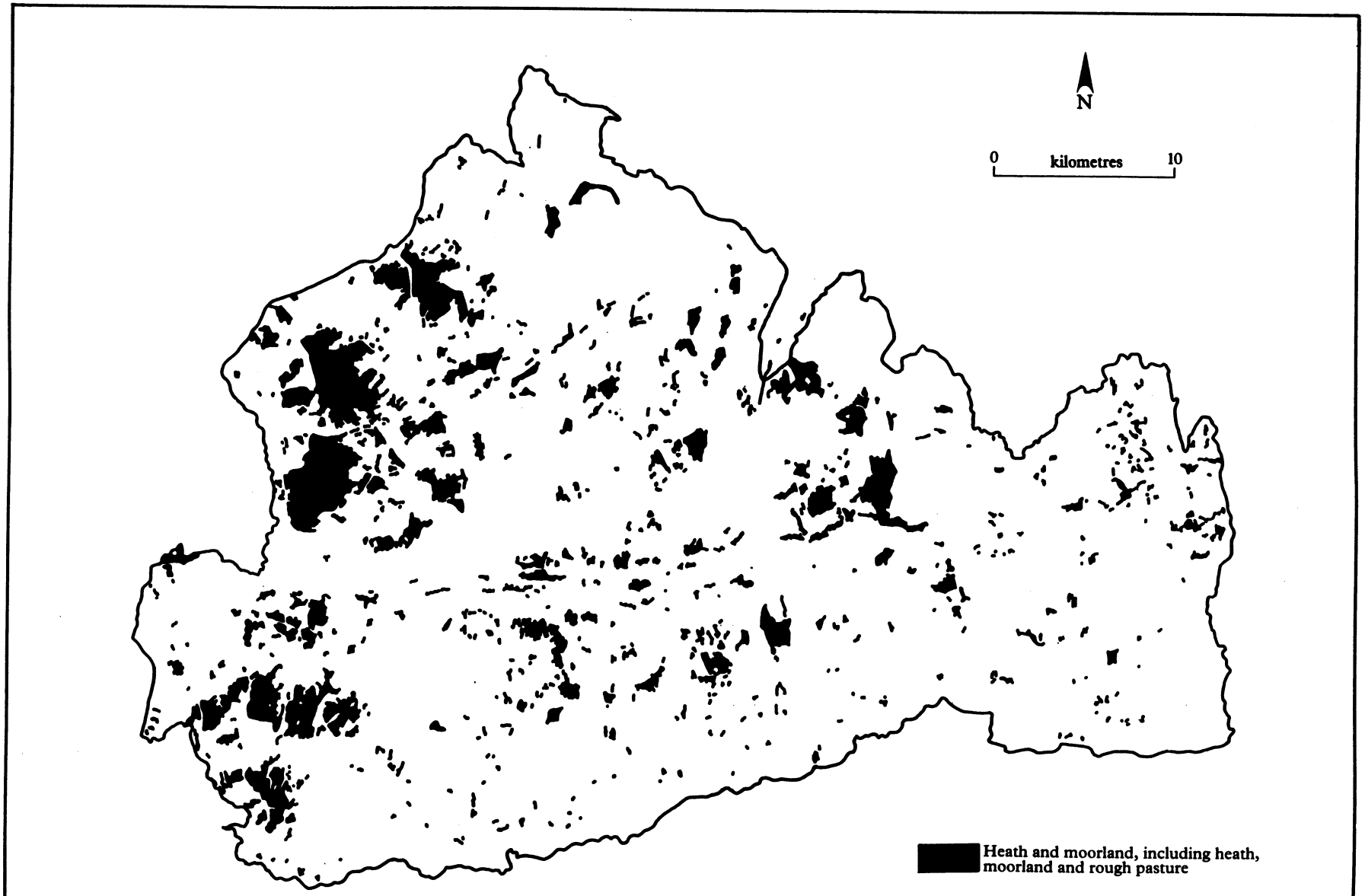


Figure 15 Distribution of heathland in Surrey in 1931 (from First Land Utilisation Survey)

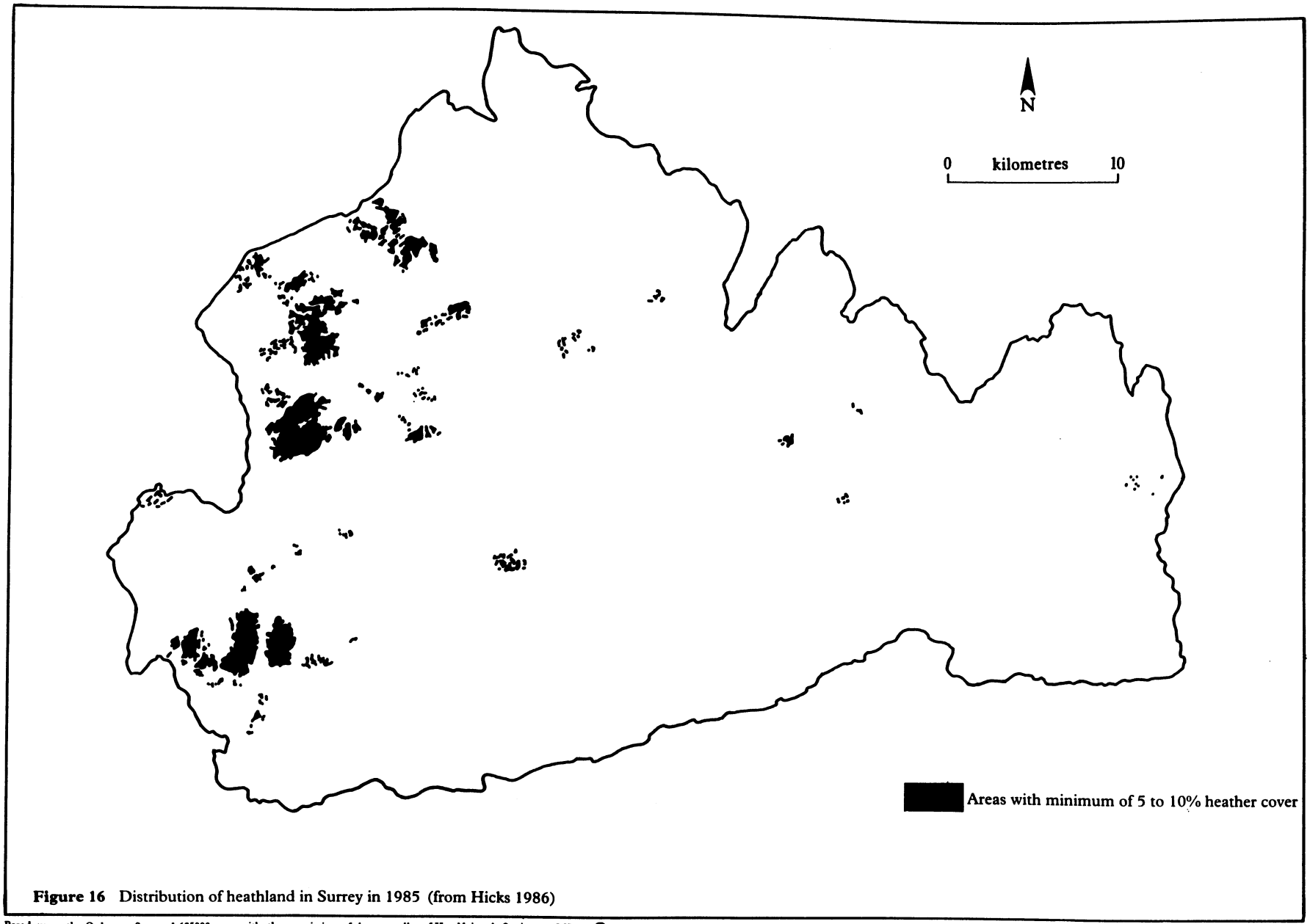


Figure 16 Distribution of heathland in Surrey in 1985 (from Hicks 1986)

TABLE 6 **Estimate of the changing extent of heathland in Surrey**

(Compiled from Hale (1984) and others)

Date	Area in hectares	Rate of decline (or increase)	Source of information	Heathland definition used	Cause of loss (gain)
1762	22,780 (rough estimate from map)		Rocque's map of Surrey 2" to 1 mile. Hale 1984 unpublished.	Open areas on acid substrate - may incorporate areas of grass heath, bracken, etc.	
1793	20,540	10%	James & Malcolm 1794	Open areas on acid substrate	
1807	19,510	5%	Stevenson 1809	Open areas on acid substrate	
1816	20,160 (rough estimate from map)	3% (increase)	1st Edition OS maps (sheets 79 & 80) Hale 1984 1" to 1 mile	Open areas on acid substrate	
1863	20,020 (rough estimate from map)	0.7%	Brewer 1863 (Flora of Surrey)	Open areas on acid substrate	Indications of start of fragmentation
1931	11,641 (optimistic estimate)	42%	1931-6 Land Utilization Survey (L D Stamp) - from sheets 114, 115, 124 & 125 - University Library Cambridge	Areas shown on maps include heath, moorland, commons and rough pasture	

Table 6 (continued)

Date	Area in hectares	Rate of decline	Source of information	Heathland definition used	Cause of loss
1967-69	8,930 (rough estimate from map)	23%	3rd Edition OS maps 1 inch to 1 mile, sheets 169-71, 180 (first published 1940, revised?) Hale 1984	Open land on acid substrate	Bracken invasion followed development of woodland with reduction in grazing pressure. Spread of pine, birch, bracken and rhododendron.
1983	5,901	34%	Tubbs 1985. Figures derived from SSSI maps, etc.	Mosaic of communities including acid grassland, valley & seepage step mires, and transitional habitats set in a matrix of ericaceous vegetation	Successional losses or conversion to monospecific stands of bracken
1985	3,060 (field survey)	48%	Hicks 1985	Much stricter definition: areas with a minimum of 5 to 10% heather	Succession to scrub and woodland

Main losses of heathland, particularly since the 1960s, may be attributed to:

1. the cessation of grazing, both by stock animals and by rabbits (due to myxomatosis);
2. the planting of pines over large tracts of former heathland;
3. the regeneration of pine and birch - encroaching onto heathland;
4. increasing public pressure resulting in degeneration to coarse grass-dominated vegetation and soil erosion.

In addition to the botanical information for Esher and Oxshott, there are many entomological data. The first description of the associated fauna of the pinewoods is for 1924 (Summerhayes, Cole & Williams 1924). The fauna of this community is specialised because of the limited variety of food and the lack of light. A full description of the felled and burnt successions was written in 1926 (Richards 1926).

The fauna of the open heathland of Esher was rich in species, including many rarities, but it is no longer as remarkable and many of the specialities are scarce or absent (Stubbs 1979). However, the pinewood still holds a rich variety, including species recorded for the first time in Britain.

Evidence that agricultural reclamation did not account for the loss of large areas of heathland before 1939 has been extracted (from Shawe 1942) by Hale (pers. comm. 1984) and is shown in Table 7. Shawe's evidence indicates considerable loss of arable land, especially during the First World War, some of which may have reverted to heathland. Since 1939 there has been little agricultural reclamation because many of the heaths are common land and many of these are owned by the Ministry of Defence. The War Office took over 3,320 ha of commons, mainly heathland, between about 1860 and 1960 (Hoskins & Stamp 1963). Some of the larger heathland areas remaining are on MoD land, eg Hankley, Pirbright and Westend Commons. Public access to these areas is restricted and they have not suffered from recreational activities; however heavy vehicles, especially on Hankley, have totally destroyed the vegetation in places, resulting in areas of exposed, bare sand.

Surrey is a particularly well-populated area and in some places recreational activities have taken their toll. Trampling has led to the destruction of the heather, which has been replaced by a grassy turf. Where there has been excessive trampling, such as around Frensham Great Pond, the vegetation has been worn away and bare sand remains. There are five main golf courses within the county totalling 58 ha, of which 43 ha are open heathland, with small quantities of scrub.

Horse-riding is popular in the county, and heaths, most of which are commons, are regularly used. Bridleways exist across many of these commons, but often the whole area is used. Heavy use by horses may cause denudation of the vegetation and churn up sandy paths, destroying any invertebrate interest.

Hampshire

There are three main heathland areas in Hampshire: southern Hampshire including the New Forest and the Isle of Wight, the Thames basin and the western Weald. The New Forest area is the most extensive, consisting of 14,370 ha of heather-dominated communities, acid grassland and valley bogs. The western end of the Weald contains approximately 1,600 ha of dry heathland and the Thames basin over 900 ha of wet and dry heathland and acid grassland (Figure 17). A summary of the ecology and history of these Hampshire heaths has been published by Hampshire County Council (1983) and contributed much of the information here.

TABLE 7 **Area of arable land on geology capable of supporting heathland in Surrey in 1939**

(Hale - From Shawe (1942), with acres converted to hectares)

Geology capable of supporting heathland	Total area in hectares	Area under arable		
		1840	1870	1939
Hythe Beds	11,831	5,702	6,128	1,193
Sandgate Beds	443	334	208	35
Bargate Beds	1,538	1,393	1,437	440
Folkestone Beds	12,717	8,446	8,949	2,952
Upper Greensand	3,144	2,119	2,138	1,211

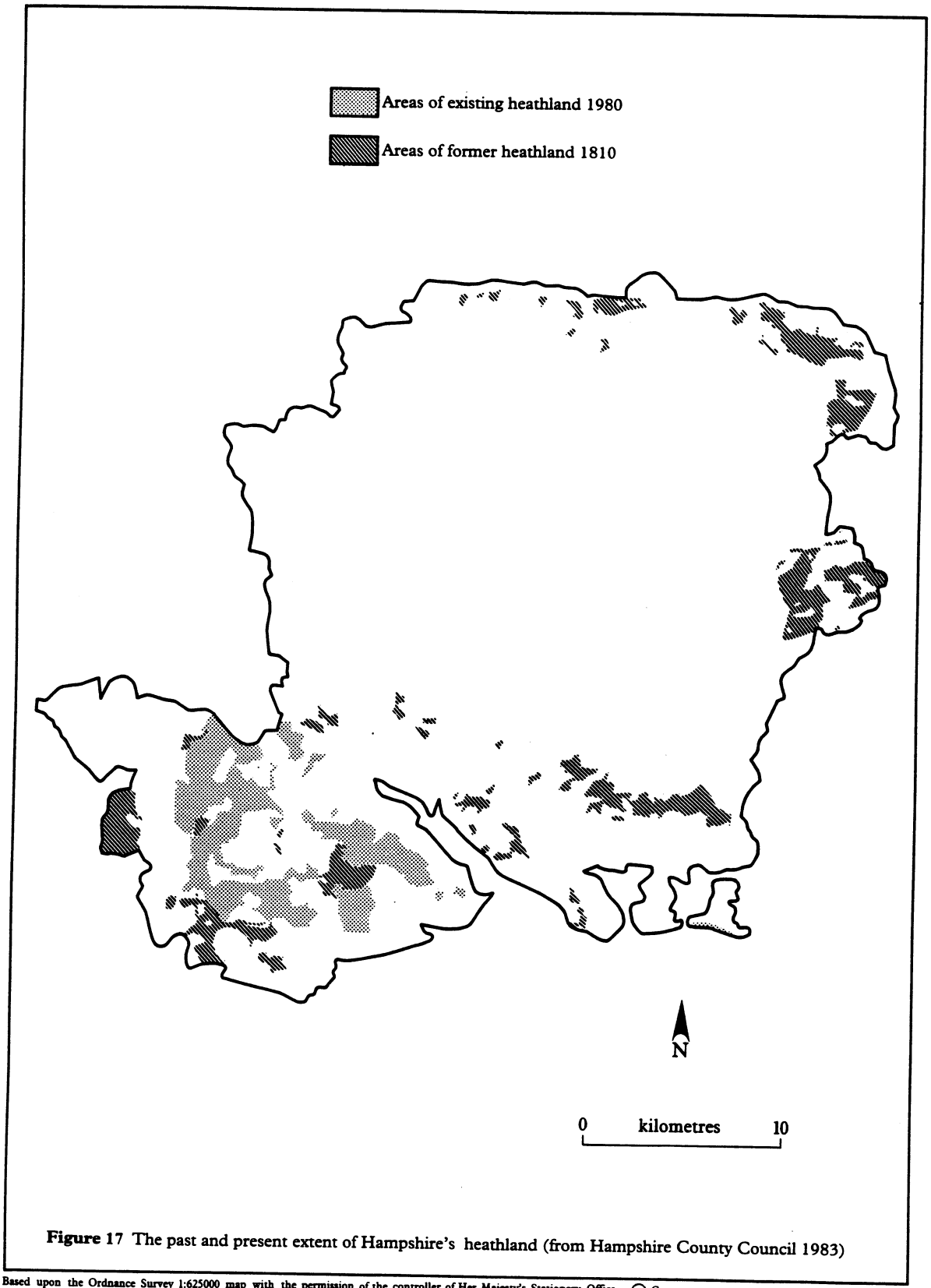


Figure 17 The past and present extent of Hampshire's heathland (from Hampshire County Council 1983)

The heathland area in Hampshire is known to have been greatly reduced since medieval times when the 11 Royal forests in the county included areas of heath. Of these, only the New Forest and Woolmer Forest retain significant areas of heathland today. In 1789, Gilbert White wrote in his *Natural History of Selborne (1977)*:

> "The Royal Forest of Woolmer is a tract of land about seven miles in length by two and a half in breadth, running nearly from north to south, and is abutted on, to begin to the south, and so to proceed eastward, by the parishes of Greatham, Lysse, Rogate and Trottan, in the county of Essex; by Bramshott, Hedleigh and Kingsley. This Royalty consists entirely of sand covered with heath and fern [bracken]; but is somewhat diversified with hills and dales, without having one standing tree in the whole extent. In the bottoms, where waters stagnate, are many bogs, which formerly abounded with subterraneous trees . . ."

Today, Woolmer Forest is a Site of Special Scientific Interest, covering only 241 ha instead of the 4,532 ha estimated by Gilbert White. In the New Forest extensive heathland areas remain, because the original Royal forest laws allowing enclosure and cultivation under licence were rarely enforced. Rights of common in the New Forest were first recognised in 1851 and continue to be exercised. Grazing rights were jealously guarded by the commoners and later by the verderers. Retention of these rights of common has prevented the improvement of extensive areas, to the advantage of the heathland vegetation.

Many of Hampshire's heaths were, and still are, common land either in or outside Royal forests. While it cannot be assumed that all common land was heathland, decline in heathland is closely linked to the gradual erosion of the commons through enclosure for agricultural improvement during the 19th century. The first General Enclosure Act was passed in 1801 and enclosures proceeded rapidly after that. In 1867 William Cobbett described the changing scene:

> "A few mud cottages on an unenclosed common tenanted by labourers and squatters have, since the enclosures of Botley Common in 1863, become the populous and thriving village of Hedge End."

The decline in the extent of Hampshire heaths is documented in Table 8. Outside the New Forest, losses have been proportionately greater than within it.

For example, in the mid-1500s heathland covered about one quarter of the Isle of Wight. This may have been heath in the widest sense, encompassing rough grassland, gorse and bracken. The majority of these sites were destroyed by 1750 (Chatters pers. comm. 1985). In 1850 the total area of heath was 729 ha, including areas dominated by gorse and other invasive species, but not chalk heaths. Further decline took place and by 1932 only 504 ha remained. Since then the loss has accelerated, further fragmenting the heathland (Table 9). Of the 504 ha existing in 1932, 29% has been lost to agriculture, 21% to forestry, 15% to mineral extraction and 9% to urban and industrial expansion (Chatters pers. comm.). There is only one area remaining that is over 40 ha in extent, whilst 18 sites are less than 1.9 ha.

The inclusion of the New Forest heaths gives Hampshire a greater extent of heathland than any other county in England. Decline in its heathlands is continuing (Table 8) and it can be seen from Table 10 that today individual heaths are small in extent with only seven sites greater than 100 hectares. A high proportion of these sites, however, now have informal or formal protection.

TABLE 8 **Estimate of the changing extent of Hampshire heaths**

Date	Area in hectares	Rate of decline (or increase)	Source of information	Heathland definition used	Cause of loss (gain)
1792	46,540		Driver brothers (1792) - County Agricultural Survey	Total area of wasteland (excluding forests), open heathland and uncultivated land	
1810	c.37,000	20%	1st Edition OS maps, 1 inch to 1 mile		Enclosures, 1801 onwards
1873	16,796	55%	Parliamentary enquiry on extent of commons, including many heaths (Cobbett 1867)	"Commons" - excludes New Forest and Isle of Wight	Enclosures led to clearance of heath for agricultural use or tree planting
1966	18,268	9% (increase)	Tubbs 1985	Mosaic of communities which include acid grassland, valley & seepage step mires, and transitional habitats set in a matrix of ericaceous vegetation	
1980	17,473	4%	Tubbs 1985		Mainly afforestation, agricultural reclamation, gravel extraction, reservoir construction, pine invasion, motorways and other road development, or damaged by military use
1982	16,865	3.5%	Hampshire County Council 1983	Impoverished soil covered by heather and other dwarf vegetation, relatively free from trees but often containing scrub, gorse and bracken	

TABLE 9 **Estimate of the changing extent of lowland heathland (Chatters pers. comm. 1985) on the Isle of Wight**

Date	Area (in hectares)	Rate of decline
c. 1850	729	
1932	504	31%
1956	332	34%
1984	133	60%

TABLE 10 Heathland in Hampshire

Name	OS grid reference	Area (ha)	STATUS	DRY	WET	HUMID	ACID GRASS	VALLEY BOG	SCRUB
South Hampshire and the New Forest area									
Baddesley Common	393215	37	SSSI	✓	✓	✓	✓	✓	✓
Badminston Common	455020	30					✓		
Browndown	580990	64.6	SSSI	✓			✓		✓
Burton	195955	40.5	SSSI	✓					
Chark Common	575023	41		✓					✓
Cranemoor	207949	15.5		✓					
Hamble	480061	23	Common	✓			✓		✓
New Forest area	298081	14,370	SSSI, Common, FC, NT	✓	✓	✓	✓	✓	✓
Shedfield Common	563130	13	Common						
Shelley Common	315190	25							
Sinah Common	695993	10			✓				
Thames Basin									
Bartley Heath and Hook Common	725530	65			✓	✓			✓
Bourley Water	830502	152	MoD	✓				✓	
Eelmoor Marsh	840533	70.7	SSSI, RAE		✓			✓	
Hazeley Heath	753583	175.7	SSSI, Common		✓	✓	✓	✓	✓
Heckfield Heath	720620	75							
Long Valley	840520	350	MoD	✓					✓
Newtown & Burghclere Commons	475627	10	SSSI, MoD, CC, Common, Village Green	✓			✓		✓

Table 10 (continued)

Name	OS grid reference	Area (ha)	STATUS	DRY	WET	HUMID	ACID GRASS	VALLEY BOG	SCRUB
Silchester Common	616611	38	SSSI, Common	✓			✓		
Tadley Common	606623	31.5		✓	✓				
Yateley Common	833590	218	SSSI, Common, MoD	✓		✓	✓		
Western Weald									
Blackmoor	737333	32.3	SSSI	✓	✓	✓			
Bramshott & Ludshott	857345	378	SSSI, MoD, NT, Common	✓			✓	✓	✓
Broxhead Common	806374	34.5	SSSI, LNR, CC, Common	✓					✓
Canford Moor	821331	18.2	SSSI, NT, Common	✓	✓	✓		✓	✓
Greatham Moor	782295	33	part MoD						
Kingsley Common	792381	45	MoD, Common	✓			✓		✓
Passfield Common	815335	20	NT, Common				✓		
Shortheath	775366	60	SSSI, MoD, Common	✓			✓	✓	
Slab Common	778350	120	Common, MoD					✓	
Woolmer Forest	795320	241	SSSI, MoD	✓		✓		✓	

KEY
FC Forestry Commission
MoD Ministry of Defence
NT National Trust
RAE Royal Aircraft Establishment
LNR Local Nature Reserve
CC County Council
SSSI Site of Special Scientific Interest

The Hampshire heaths are significant refuges for two bird species. These are the woodlark *Lullula arborea* and the Dartford warbler *Sylvia undata.* The woodlark's main strongholds are now in Hampshire and Surrey. It was widespread throughout England and Wales during the 19th century, but has withdrawn southwards since. A gradual increase was recorded in south-east England between 1920 and 1951 (Parslow 1973). After 1954, however, a decline began which accelerated after the severe winters of the early 1960s. Since then the relict population has been virtually confined to the lowland heaths throughout the south of England. A survey in Hampshire in 1981 recorded 116 pairs, of which all but 11 pairs were found on heaths (Tubbs 1985). On the south-west Surrey heaths 104 pairs were found in 1981. Tubbs suggests that the total British population may have then been no more than double the number found in Hampshire and Surrey.

The New Forest holds most of the breeding pairs of Dartford warblers in England. The Dartford warbler is vulnerable to severe winters and its populations fluctuate accordingly. After the 1962/63 winter there may have been only 11 pairs left in the UK (Tubbs 1985). However, due to a series of mild winters the total number of pairs was over 600 in 1988, over 450 of which were in the New Forest (Westerhoff & Tubbs 1991).

The Dorset heaths

The Dorset heaths are concentrated on the sands and gravels of the Tertiary deposits of the Poole basin and the south-east part of the county. These heaths are of ecological interest, not only because of their extent but also because species with eastern and continental distributions overlap with those which have western and oceanic characteristics. The heaths are essentially Atlantic in their classification, but contain elements of both Armorican heath, chiefly characterised by *Erica cinerea, Erica ciliaris* and *Ulex gallii*, and Anglo-Norman heath, in which *Erica cinerea* and *Ulex minor* are the dominant species (Noirfalise & Vanesse 1976).

Development of open heath in the Poole basin of Dorset began in the Bronze Age, around 1650 BC. Heathland increased with woodland clearance, grazing, and possibly a change in the climate until 1000 BC (Haskins 1978). Traditional uses of heaths practised until well into the 18th century included rough grazing, fuel gathering and periodic burning. Grazing had almost ceased by the end of the 19th century and fuelwood gathering ceased once the railways made coal readily available. Agricultural reclamation increased in Dorset, and elsewhere, during the present century due to an expanded demand for food.

Some idea of the vastness and character of the heaths in the 19th century can be gained from the writings of Thomas Hardy. In his book *The Return of the Native* (1878), set in Wessex, he writes:

> "Twilight combined with the scenery of Egdon Heath to evolve a thing majestic without severity, impressive without showiness, emphatic in its admonitions, grand in its simplicity ...."

and

> "To recline on a stump of thorn in the central valley of Egdon, between afternoon and night, as now, where the eye could reach nothing of the world outside the summits and shoulders of heathland which filled the whole circumference of its glance, and to know that everything around and underneath had been from prehistoric times as unaltered as the stars overhead, gave ballast to the mind adrift on change, and harassed by the irrepressible new. The great inviolate place had an ancient permanence which the sea cannot claim."

However, in the preface to this book, Hardy writes a note about the definition of 'Egdon Heath', an area now equivalent to the area between Piddletrenthide in the west and the River Avon in the east, and notes that fragmentation of the heath had already begun.

> "Under the general name of 'Egdon Heath', which has been given to the sombre scene of the story, are unified or typified heaths of various real names, to the number of at least a dozen; these being virtually one in character and aspect, though their original unity, or partial unity, is now somewhat disguised by intrusive strips and slices brought under the plough with varying degrees of success; or planted to woodland."

A number of studies document the fragmentation of the Dorset Heaths. A summary of their findings, showing progressive loss of heathland since 1750 and the reasons for the losses, is given in Table 11.

The rate of loss of heath increased between 1750 and 1978 (Table 12). The amount of land used for agriculture fluctuated, mainly during the period between 1811 and 1896 (Moore 1962). However, the major change in the district at that time was urban development. The village called Bournemouth began in 1810, and grew from a settlement of 695 inhabitants in 1851 to a town of 16,000 by 1881 (Moore 1962). Urbanisation continued to increase during the period 1896-1934.

In 1894 golf became popular and the construction of courses began. Early in this century land was acquired by the War Department, primarily for military training, and after the Second World War mineral extraction increased. These changes in land use are summarised by Moore (Table 13).

Grazing and burning have also varied. There has been an increase in deer grazing and the use of mechanical methods of cutting roadside verges, producing a similar effect to heavy stock grazing. On the other hand, sheep, cattle and pony grazing has decreased, and the rabbit population has been greatly reduced since the outbreak of myxomatosis in 1954. The number of heathland fires has risen, mainly owing to the great increase in visitors to the area, although there has been a reduction in the use of controlled burning as a management tool for stock grazing. Fire precaution measures taken by the Forestry Commission and the natural firebreaks offered by roads have helped in reducing damage.

The exceptionally dry summer of 1976 resulted in many serious fires. Four heathland nature reserves were severely affected - Hartland Moor and Horton Common in Dorset, Pirbright Common in Surrey and Blorenge in Monmouth. The immediate effect was the complete destruction of the surface vegetation, roots and litter, with the intense heat burning through the humus and peat to the mineral soil beneath. This led to erosion and weathering of the remaining soil surface (Hearn & Gilbert 1977). Many animals were killed, and the rare sand lizard and smooth snake suffered drastic reductions in numbers. On Hartland Moor only 30 sand lizards could be found after the fire in an area previously known to have supported 700-1,000 individuals (Hearn & Gilbert 1977). Subsequently recolonisation has taken place.

The flora of the Dorset heaths seems to have changed very little since 1895, as only five species listed by Mansel-Pleydell (1895) have become extinct - grass of Parnassus *Parnassia palustris*, common butterwort *Pinguicula vulgaris*, crowberry *Empetrum nigrum*, fir clubmoss *Lycopodium selago* and stag's-horn clubmoss *L. clavatum*. These are species with a mainly northern distribution, and their loss may have been due to climatic changes.

TABLE 11 **Estimate of the changing extent of heathland in Dorset**
(Compiled from Webb & Haskins (1980) and others)

Date	Area in hectares	Rate of decline	Source of information	Heathland definition used	Cause of loss
1759	39,960		Issac Taylor's maps of Hampshire and Dorset 1" to 1 mile (after Haskins 1978)	No data	No data
1811/1817	30,400	24%	1st edition OS maps (Moore 1962, and Rippey 1973) 1" to 1 mile	All land on appropriate soil types, shown on the OS maps as rough and unenclosed. A wide definition, including areas dominated by *Calluna* and *Erica* as well as valley bogs, pine heath, gorse thickets, *Agrostis curtisii* and *Molinia caerulea* grasslands	Reclamation for agriculture and the beginnings of urban encroachment, especially around Bournemouth
1896	22,672	25%	2nd edition OS maps (Moore 1963 & Rippey 1973)		
1931-34	18,200	20%	1934 Land Utilization Survey - L D Stamp (extracted by Haskins 1978)	Heath, moorland, commons and rough pasture on acidic substrates	Afforestation and further agricultural reclamation, and urban expansion. The trend is towards fragmentation and loss of heathland

Table 11 (continued)

Date	Area in hectares	Rate of decline (or increase)	Source of information	Heathland definition used	Cause of loss (gain)
1960	10,000	45%	Moore (1962) - field surveys 1959 and 1960, recording remaining heathland acreages on 1" OS maps	Includes all heathland categories - carr and gorse, scrub, acid grasslands etc on appropriate soil types shown. OS maps as rough and unenclosed	
1973	6,100	39%	Rippey (1973)		
1978	5,832	4%	ITE Furzebrook (Webb & Haskins 1980) Field Survey	Included dry heath, with bracken and scattered scrub, humid and wet heaths and peatland. Does not include carr or gorse scrub	Continuing decline with urban development of Poole and Bournemouth, roads, and afforestation
1983	5,933	2% (increase)	NCC Phase 1 Land Use and Habitat Survey of Dorset (1983)	NCC Habitat Survey Classification. Wet, humid, dry heath and valley bog	
1987	5,141	13%	Webb (1990)	Approximately the same definition as Webb & Haskins (1980)	Development and conversion to farmland

TABLE 12 **The rates of decline in the area of heathland in the Poole Basin**
(from Webb and Haskins 1980 and Webb 1990)

Date	Interval (years)	Loss (ha)	% loss during the period *	Loss/year (ha)	% loss/year
1750-1814	64	9,650	24	151	0.4
1814-1896	82	7,728	25	94	0.3
1896-1934	38	4,472	20	118	0.5
1934-1960	26	8,200	45	315	1.7
1960-1973	13	3,900	39	300	3
1973-1978	5	268	4	54	0.8
1978-1987	9	691	13	77	1.4

* Percentage loss of the total at the beginning of the period taken from Table 11.

TABLE 13 **Land uses in 1960 of the original heathland area of east Dorset and Hampshire west of the River Avon and their areas** (from Moore 1962)

Use	Area (ha)	Percentage of total area
Agriculture	10,500	28
Urban development	8,900	23
Plantation (mostly conifer)	7,700	20
Undeveloped or lightly grazed heath	6,900	18
Government-used land - War Dept. ranges, etc	2,400	6
Mineral workings	1,200	3
Golf courses	400	1
Total	**38,000**	**99**

A detailed study of the effects of heathland changes on 10 indicator species has been carried out by Moore (1962), and a summary of his findings is given in Table 14. All of the indicator species survive on land which has been only slightly modified, whilst none of them survive the ploughing up of heath for farmland and the subsequent application of fertilisers. Mineral workings destroy the original habitat, but the areas are rapidly recolonised by both the indicator species and many others. The effects of afforestation with conifers are complicated. The indicator species survive the ploughing up, planting and initial growth of young trees. When the trees exceed the height of the heather and gorse, the species begin to disappear. The Dartford warbler is particularly susceptible. Many of the species continue to survive in the rides and on the edges of the plantations. The amount of shading is also important. The silver-studded blue and the sand lizard are absent from the less sunny rides. A clear-felled plantation retains most of its original flora and fauna, but, if some pines are left standing, a 'pine savanna' results. The presence of these pines apparently inhibits colonisation by stonechats *Saxicola torquata* and Dartford warblers.

The loss and increasing fragmentation of Dorset heathland are well illustrated in Figures 18 to 22. Because of the wealth of information available on Dorset heaths, it is possible to look at the fragmentation of the heaths in some detail.

When Isaac Taylor prepared his maps in 1759, the heaths were in 10 large blocks separated only by rivers. By 1960 they had been divided into over 100 pieces and by 1973 120 fragments of more than 4 ha were in existence. In 1978 there were 160 separate areas of heath. Webb and Haskins (1980) looked at the degree of fragmentation based on a fairly arbitrary definition of the physical isolation of heathland areas. Every area of heathland that had no contact with any adjacent piece was counted separately. Where a heath was divided by an unmetalled road, track or disused railway, the pieces were counted together, but where a metalled road or railway in use crossed the heath, the areas were estimated separately. Using this approach, the heaths of the Poole basin were seen to consist of 768 separate areas. The 13 largest sites are shown in Table 15. Webb & Haskins (1980) list 14 sites, but most of Horton Common, which covered 134 ha, was ploughed up in early 1981; approximately 50 ha remain, most of which support wet valley heath, now polluted by runoff from the surrounding reseeded areas. There are now 14 sites between 50 and 100 ha and 61 between 10 and 50 ha, leaving 680 sites of less than 10 ha in extent.

TABLE 14 Changes of land use on heathlands in Dorset: the persistence of heathland species (from Moore 1962)

Land uses involving little or no alteration of heathland	Description of land use: Land uses involving total or considerable alteration of heathland			Presence or absence of indicator species									
				Erica ciliaris Dorset heath		*Ceriagrion tenellium* Small red damselfly	*Pyrrhosoma nymphula* Large red damselfly	*Plebejus argus* Silver-studded blue butterfly	*Hipparchia semele* Grayling	*Lacerta agilis* Sand lizard	*L. vivipara* Common lizard	*Sylvia undata* Dartford warbler	*Saxicola torquata* Stonechat
	Afforestation	**Mineral workings**	**Agriculture and gardens**										
Ungrazed heath				+	+	+	+	+	+	+	+	+	+
Grazed heath				+	+	+	+	+	+	+	+	+	+
	New plantation (conifers same height as heath)			+	+	+	+	+	+	+	+	+	+
	Heath on felled conifer plantations			+	+	+	+	+	+	+	+	+	+
		Old workings, more than 75% recolonized heath		+	+	+	+	+	+	+	+	+	+
		Old workings partly (25-75%) recolonized heath		/	+	+	+	+	+	+	+	+	+
War Department ranges				/	+	+	+	+	+	+	+	+	+
Golf courses				+	+	+	?	+	+	+	+	+	+
Heathland surrounded by urban development for 10 yrs or more					+	+	?	+	+	+	+	+	+
	Rides and edges of half-grown plantations			+	+	+	+	+	+	+	?		+
	Pine heath savanna			+	+	+	+	+	+	+	+		
	Rides and edges of mature plantations			+	+	+	+		+		+		
	Half-grown plantations (conifers 10-20 ft)			+	+	/	/	+	+	?	?		+
			Gardens with no heather or gorse				+			+	+		
			Agricultural land with gorse hedges			/	/			+	+		
			Agricultural land with no gorse in hedges				?			+	+		
	Mature conifer plantation					/	/						
		New mineral workings											

+ = Observed / = No suitable habitat in land category

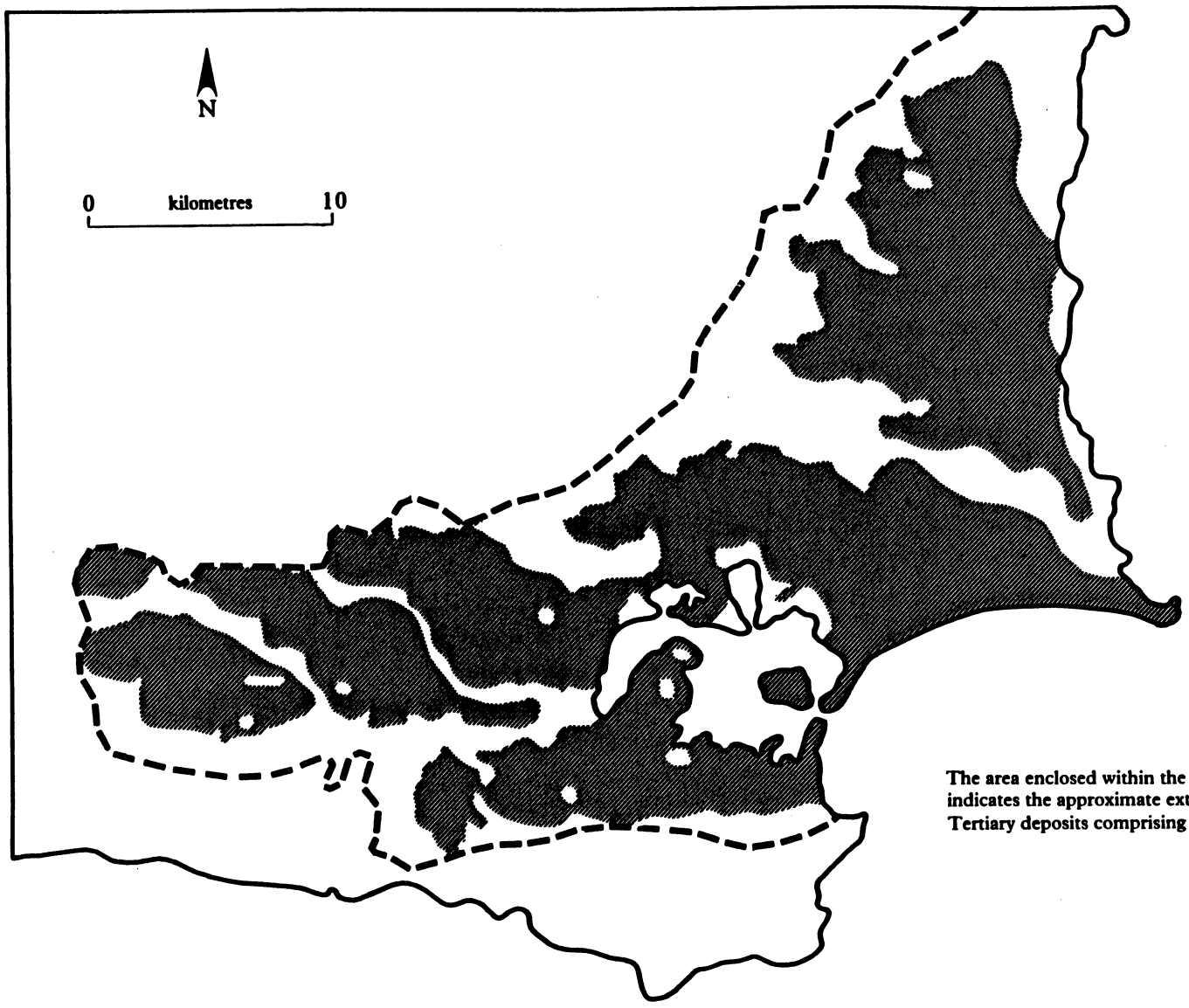


Figure 18 The extent of heathland in the Poole Basin in 1759 (from Webb and Haskins 1980)

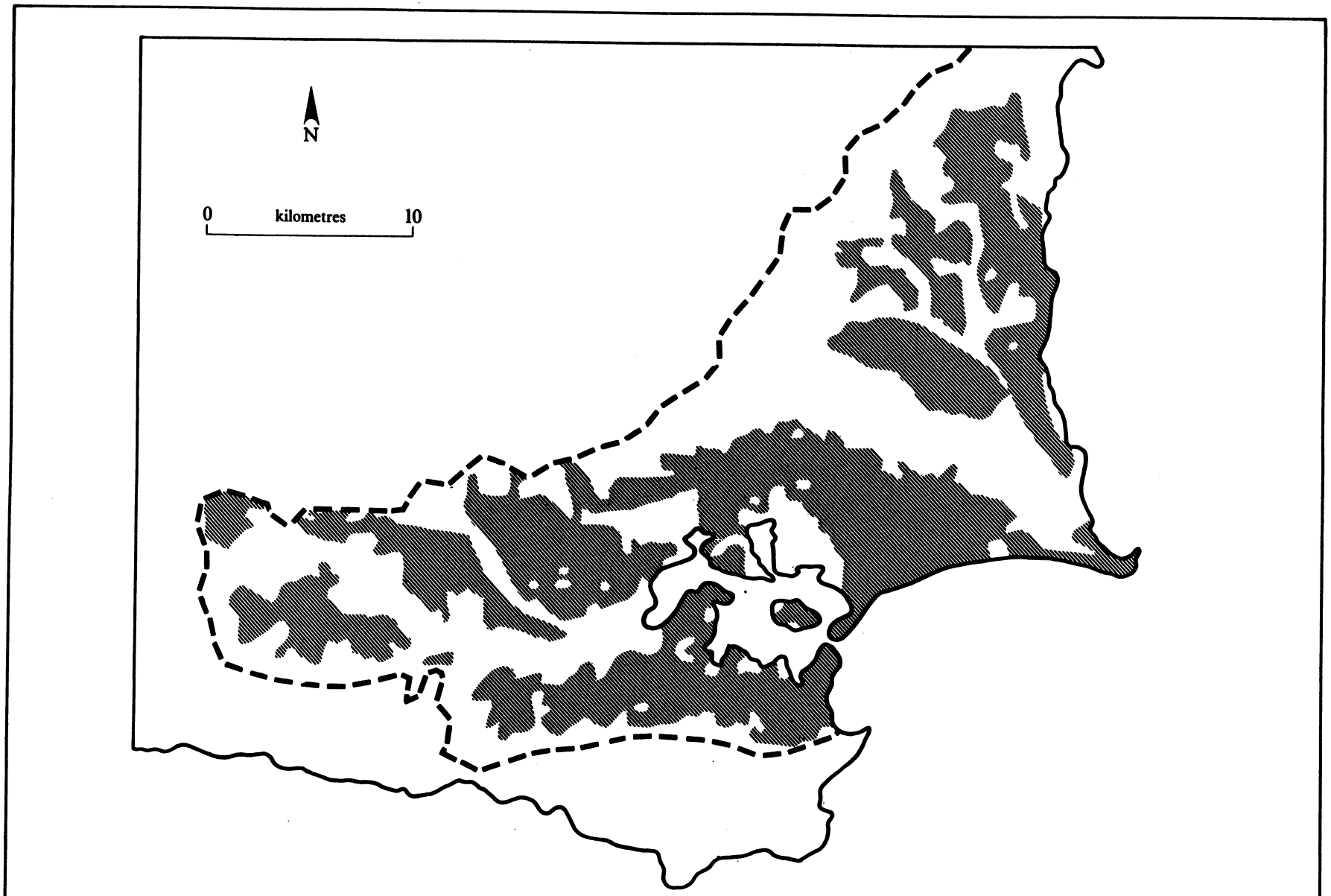


Figure 19 The extent of heathland in the Poole Basin in 1811 (from Webb and Haskins 1980)

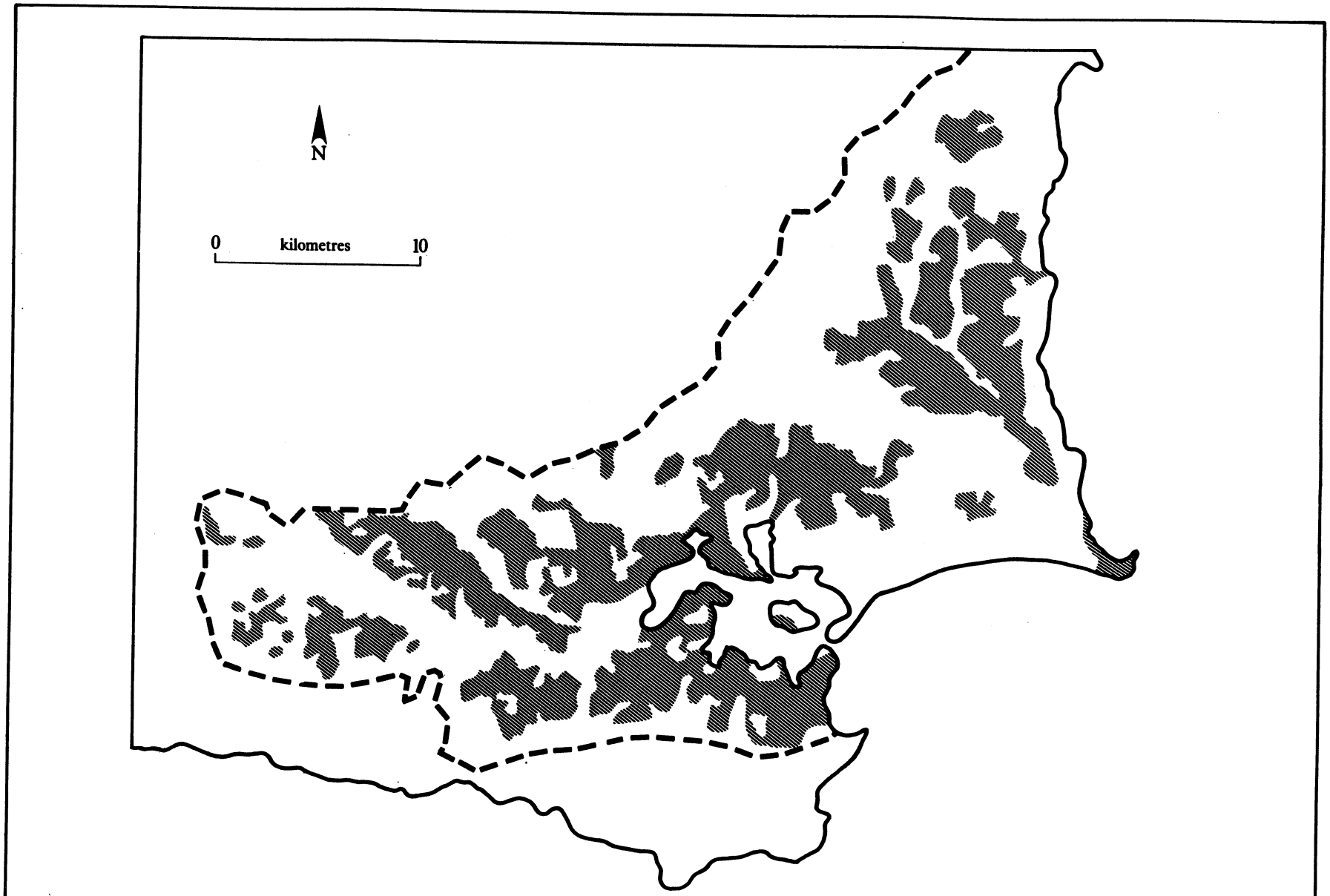


Figure 20 The extent of heathland in the Poole Basin in 1934 (from Webb and Haskins 1980)

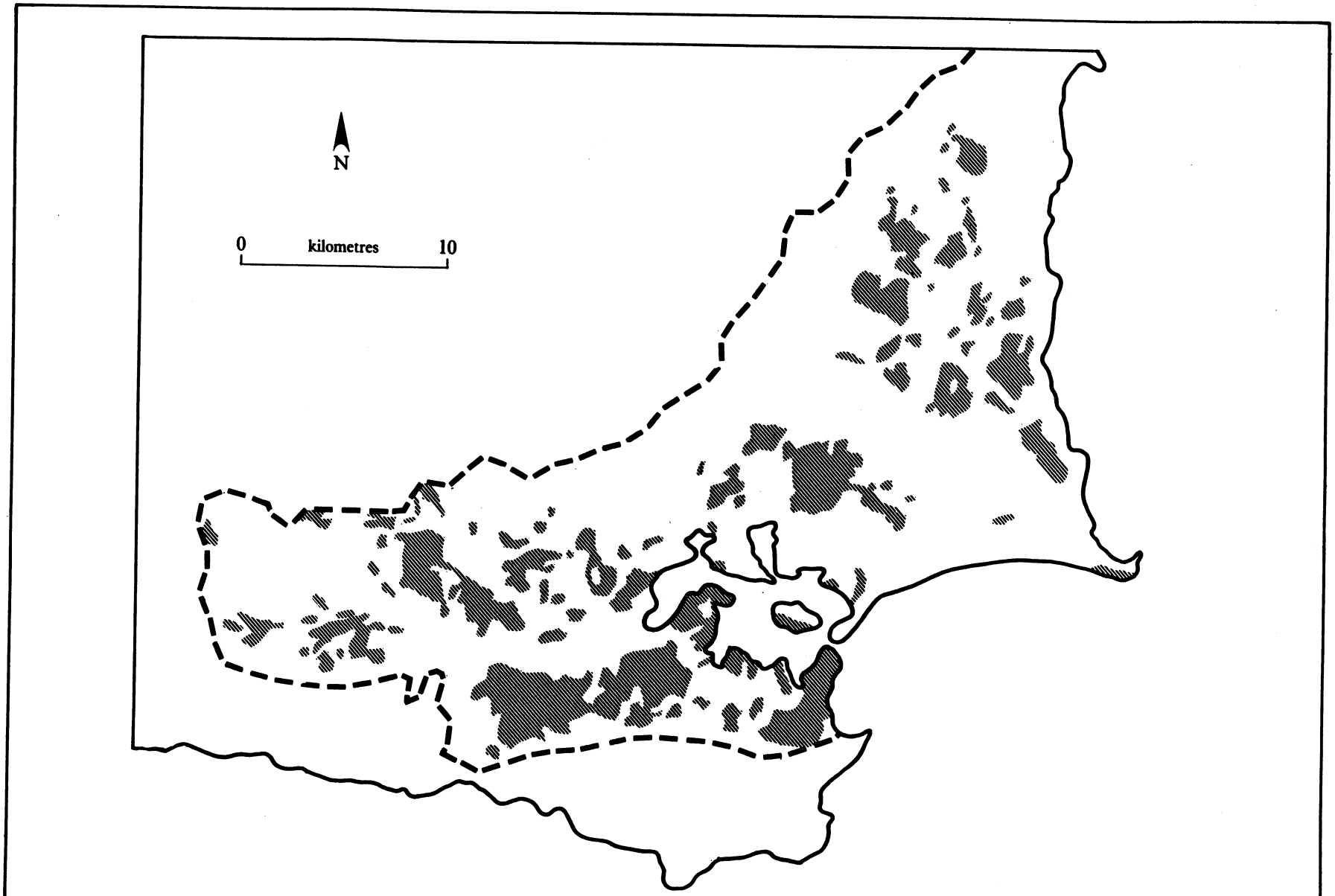


Figure 21 The extent of heathland in the Poole Basin in 1960 (from Webb and Haskins 1980)

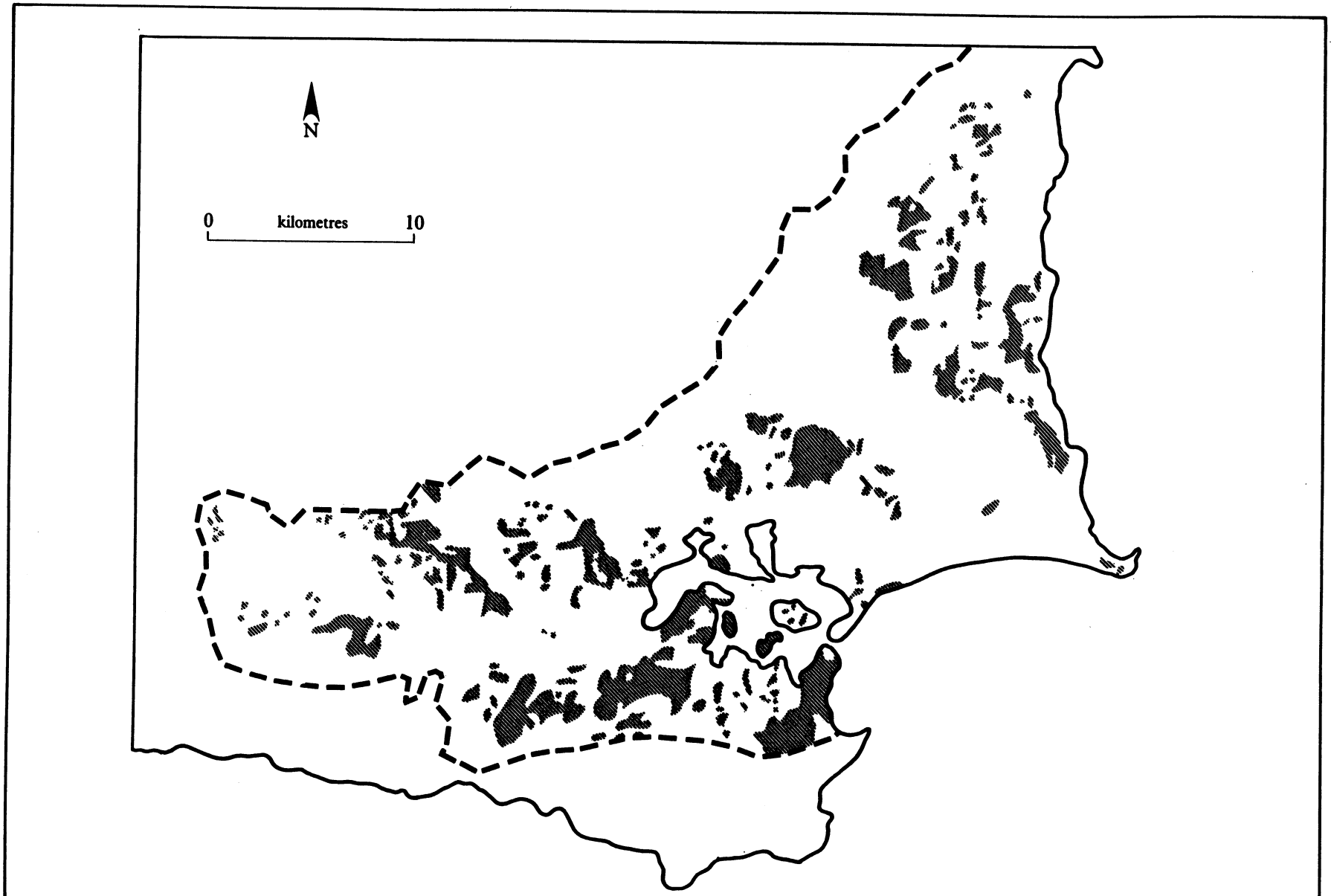


Figure 22 The extent of heathland in the Poole Basin in 1978 (from Webb and Haskins 1980)

TABLE 15 **Heathland sites over 100 ha in area in the Poole Basin**
(revised from Webb and Haskins 1980)

Site	ha
West Moors	107
Christchurch Town Common	108
Parley Common	120
Turners Puddle Heath	145
Arne Heath	145
Morden Bog	152
Upton Heath	171
Barnsfield Heath	184
Povington Heath	186
Hartland Moor	246
Holt Heath (South)	284
Godlingston Heath	406
Canford Heath	476

The Lizard, Cornwall

The Lizard peninsula is the most southerly part of mainland Britain. It is a plateau at about 90 m above sea level, bounded by sea on the west, south and east, and extending for 11 to 16 km from east to west, and for 10 to 14 km from north to south. The peninsula is composed of igneous or metamorphic rocks of pre-Cambrian age, but is best known for its serpentine outcrop which, covering 50 km^2, is the most extensive in Britain. The soils overlying the serpentine are the least fertile in the area and as a result have been little cultivated. They are slightly alkaline and lack calcium, potassium and phosphates. As in other areas with alkaline soils, the heath vegetation has only developed where the soils are low in bases, although soils developed on the rock types other than serpentine also support some heath vegetation, adding to the heathland diversity. The climate of the Lizard is oceanic, with the highest average mean daily temperatures in Britain, at 11 °C, and an average annual rainfall around 1,000 mm. The area receives many strong winds. The climate also has Mediterranean tendencies with frequent spring droughts and a high rate of insolation.

Most of the serpentine area is covered with heath vegetation, in which 10 species play an important part in determining the physiognomy and structure (Coombe & Frost 1956). These are:

Agrostis curtisii	Bristle bent
Calluna vulgaris	Heather
Erica cinerea	Bell heather
Erica tetralix	Cross-leaved heath
Erica vagans	Cornish heath
Festuca ovina	Sheep's fescue
Molinia caerulea	Purple moor-grass
Schoenus nigricans	Black bog-rush
Ulex europaeus	Gorse
Ulex gallii	Western gorse

Coombe & Frost (1956) also distinguish four main heath communities:

Rock heath
Mixed heath
Tall heath
Short heath

In a European context, these heath types are related to communities occurring in south-western France. In general, the 'Mixed', 'Tall' and 'Short' types belong to a strictly oceanic *Calluna-Ulex gallii* heath complex, which has a marked westerly distribution in Britain and France. In detail, the composition of the soils and plant associations of 'Rock', 'Mixed' and 'Tall' heath appear to be unique to Britain, whilst 'Short' heath is a very local association better developed on the Lizard than elsewhere in the UK.

An abundance of Bronze Age tumuli and extensive earthworks indicate that Bronze Age and Iron Age cultures were well established on the Lizard. Pollen from a Bronze Age tumulus at Higher Polverack (Smyth 1974) suggest that heathland vegetation was present during this period. The next piece of evidence for heathland extent on the Lizard comes from the Anglo-Saxon period. After the Saxon conquest land grants were made, the accounts of which give details of the perimeters of the areas involved. Oliver Rackham and David Coombe have studied these documents and have tentatively been able to identify the boundary between unenclosed heath and the area of cultivation. The boundaries of the unenclosed heath are defined by a 'perambulation' traceable on the ground by intervisible points. Some areas of heath, for instance the northern edge of Goonhilly Down, have a similar boundary today as they had in the Saxon period. However, other points are no longer intervisible due to the development of scrub, suggesting that some Lizard heaths were more open in the past than today (Hopkins 1980).

In Medieval times, Carew (1602) stated that "the Cornish people gave themselves principally to the seeking of tin and neglected husbandry . . .", implying that little land was relcaimed for agriculture. However, he also comments that "barley is grown into great use of late so as now they fill a larger quantity of one hundred than was in the shire before." Carew attributed this growth in agricultural activity to the increased availability of labour as the population recovered after the Black Death. The first map of Cornwall was drawn in 1600 by Norden, but it is not sufficiently detailed to use in landscape interpretation. Several other maps by Gascoine (1700) and Martyn (1748) exist, but it is not until the first edition of the one inch Ordnance Survey map, published in 1813, that there is any detailed information on heathland, woodland and field boundaries. The extent of the heath at this time was approximately 2,720 ha (see Table 16).

TABLE 16 **Estimate of the changing extent of the Lizard heaths**

Date	Area in hectares	Rate of decline (or increase)	Source of information	Cause of loss (gain)
1813	2,270		1st edition OS maps, 1 inch to 1 mile (Hopkins 1980)	Much heathland brought into agricultural usage during the Napoleonic Wars
1880	3,610	59% (increase)	1st edition OS maps, 6 inches to 1 mile (Hopkins 1980)	Depression in agriculture following wars led to reversion to heathland
1908	3,660	1% (increase)	2nd edition OS maps, 6 inches to 1 mile (Hopkins 1980)	
1963	3,280	10%	3rd edition OS maps, 6 inches to 1 mile	Establishment of forestry on Goonhilly Down, agricultural reclamation and building of satellite tracking station
1980	2,520	23%	Field Survey (Hopkins 1980)	Agricultural reclamation

Large numbers of enclosures which today support heathland are shown as agricultural land in 1813, suggesting that extensive reclamation of heathland had taken place during the Napoleonic Wars. Confirmation of reclamation and subsequent reversion of agricultural land to heath after the wars is given by Thomas, who farmed at Predannack Wollas in 1869 (C.R.O. DDX 265/11) - "A great deal of wasteland was brought under cultivation before the close of the last French war, which after the peace, in many instances was again left to run to a state of nature, after the depression which fell upon the nation after such a long war."

By 1875, the economic depression had caused Cornwall to have one of the smallest areas of tillage and lowest numbers of cattle per acre of cultivable land in England (Collins 1978). This was reflected in the 59% net increase in heathland extent between 1813 and 1880 when the first edition of the six inch Ordnance Survey map was published (Table 16). This trend is well illustrated in Figures 23 and 24. Since 1880, heathland losses on the Lizard have been relatively small by comparison with other heathland areas in Britain (Table 16, Figures 23 to 27). The second edition of the six inch Ordnance Survey maps published in 1908 and aerial photographs taken in 1946 show a virtually unchanged heathland extent over this period, with the exception of the loss of parts of Higher Predannack Downs owing to the construction of Predannack airfield. Since then losses have been due to the establishment of a forestry plot on Goonhilly Down, the construction of the Goonhilly Down tracking station (although much of the heathland inside the area is conserved, part as a Site of Special Scientific Interest) and most recently to agricultural reclamation (Hopkins 1980). Table 17 documents the causes of the 31% heathland loss between 1908 and 1980.

Today there is an awareness of the outstanding biological, geological and landscape value of the Lizard, and in 1975 40 ha of Goonhilly Down were declared the first National Nature Reserve in Cornwall. The reserve has now been extended to encompass 600 ha of heathland and cliff, including Crousa Downs and Mullion Cliffs. Other parts of the Lizard are protected by the National Trust or are managed as nature reserves by the Cornwall Naturalists Trust, giving a total of 810 ha in nature reserves.

Other areas

There were large areas of heath in eastern England. Three sites remain in Yorkshire of a once much larger tract of damp heathland (Goode 1964). These are Allerthorpe, Skipwith and Strensall Commons. They have survived mainly because they are common land. Allerthorpe was planted up with conifers to a large extent in the 1960s, but some areas of heather remain. At Skipwith Common sheep grazing has been re-introduced on parts of the site to control birch regeneration.

South of the Humber estuary, the geology changes and the 'Coversand' heaths, similar to the Breckland but not as botanically rich, are found. This used to be an extensive area stretching from Scunthorpe to near Gainsborough, a distance of about 15 miles. Much of the heath has disappeared this century. Some has been afforested, some brought into cultivation, and some destroyed by ironstone mining and more recently by sand excavation (Smith 1984). Nearly all the remaining examples are in nature reserves.

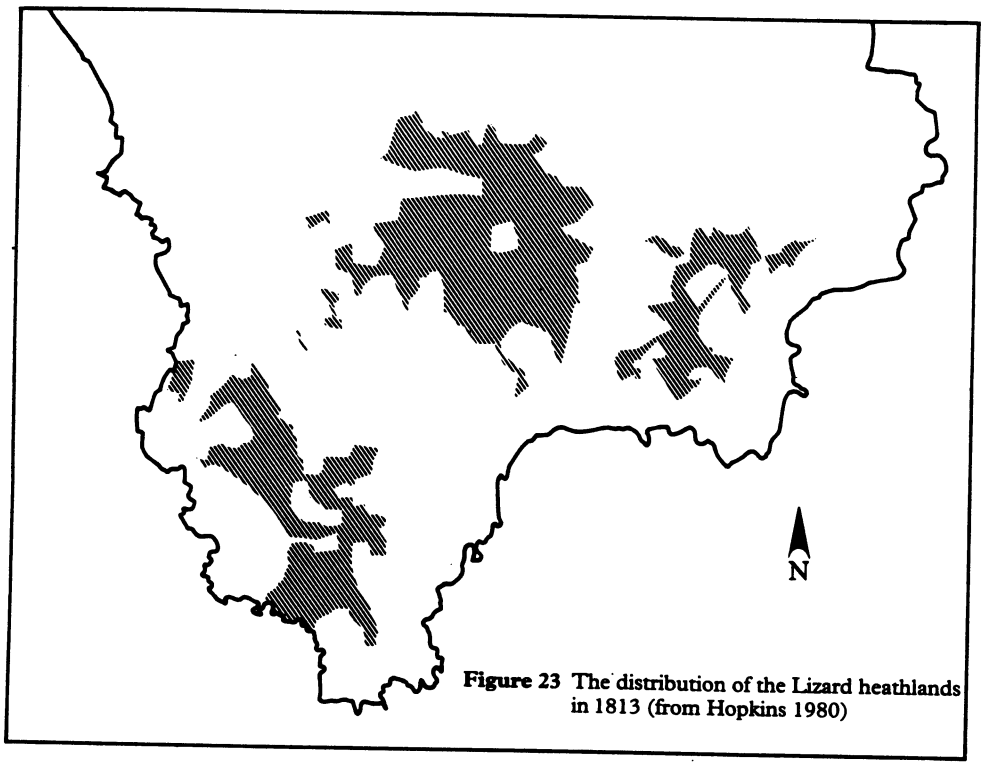


Figure 23 The distribution of the Lizard heathlands in 1813 (from Hopkins 1980)

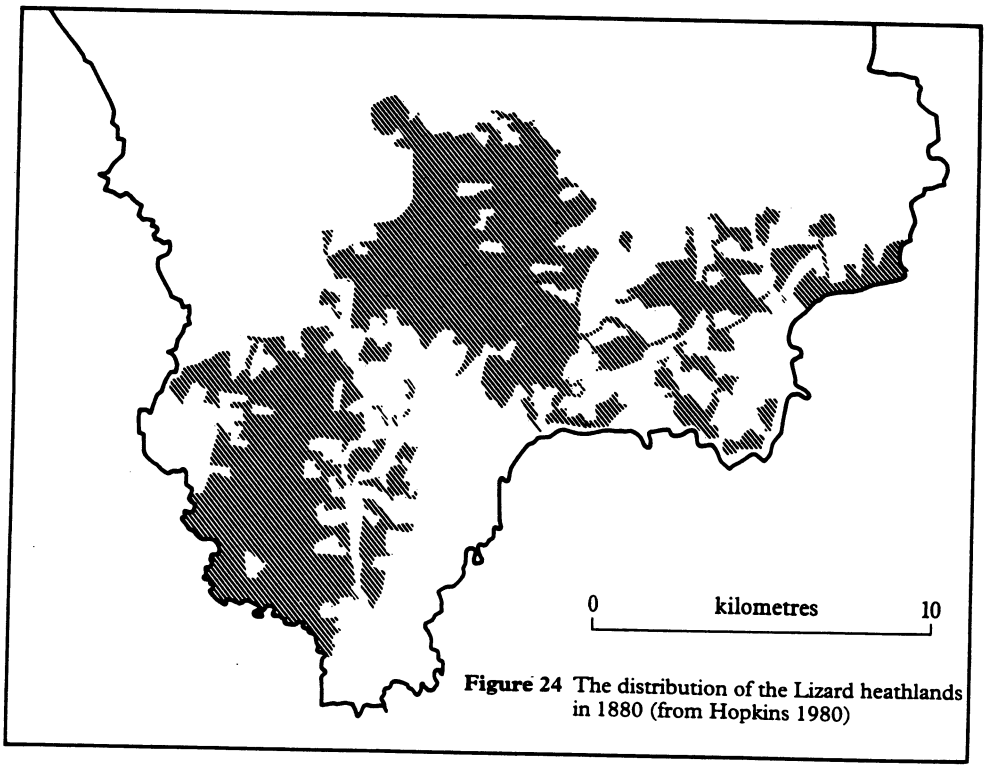


Figure 24 The distribution of the Lizard heathlands in 1880 (from Hopkins 1980)

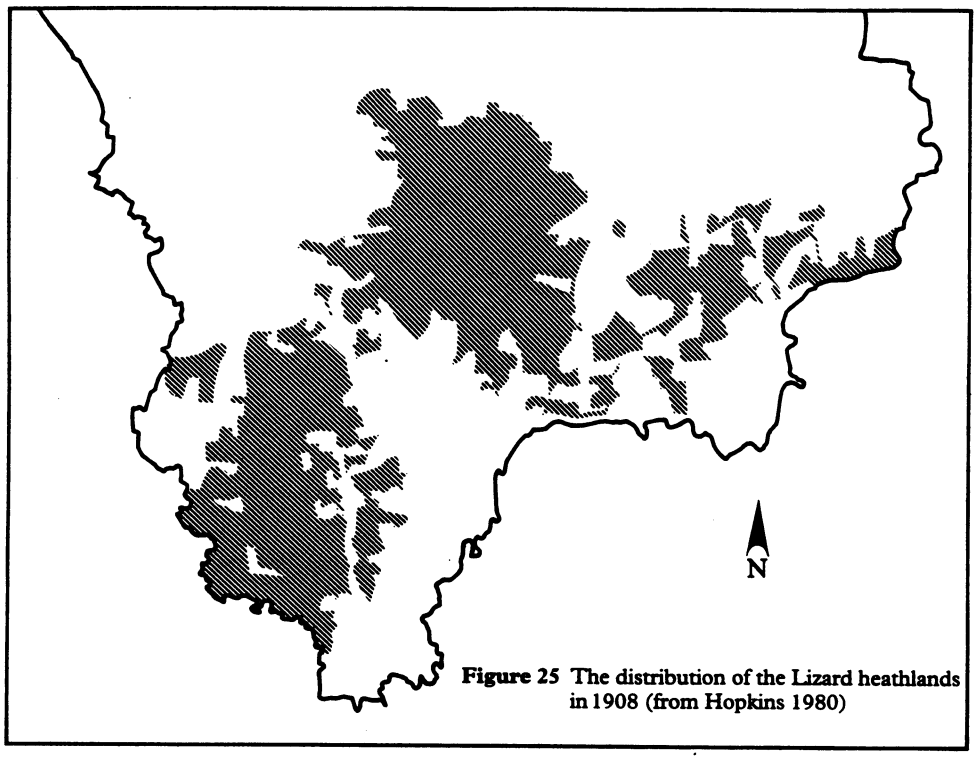


Figure 25 The distribution of the Lizard heathlands in 1908 (from Hopkins 1980)

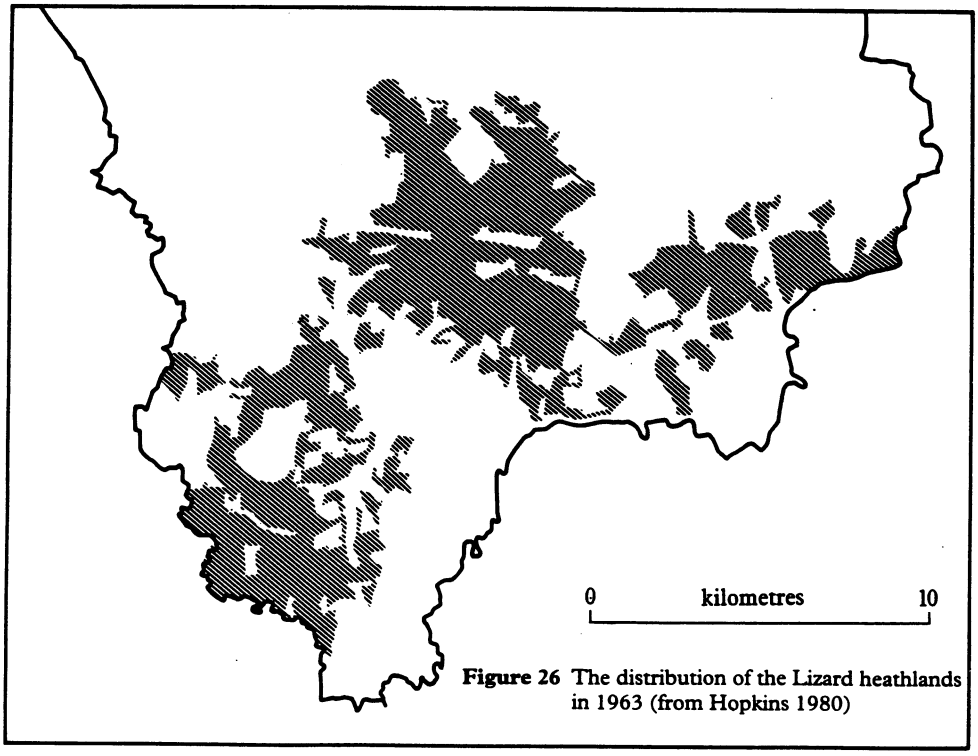


Figure 26 The distribution of the Lizard heathlands in 1963 (from Hopkins 1980)

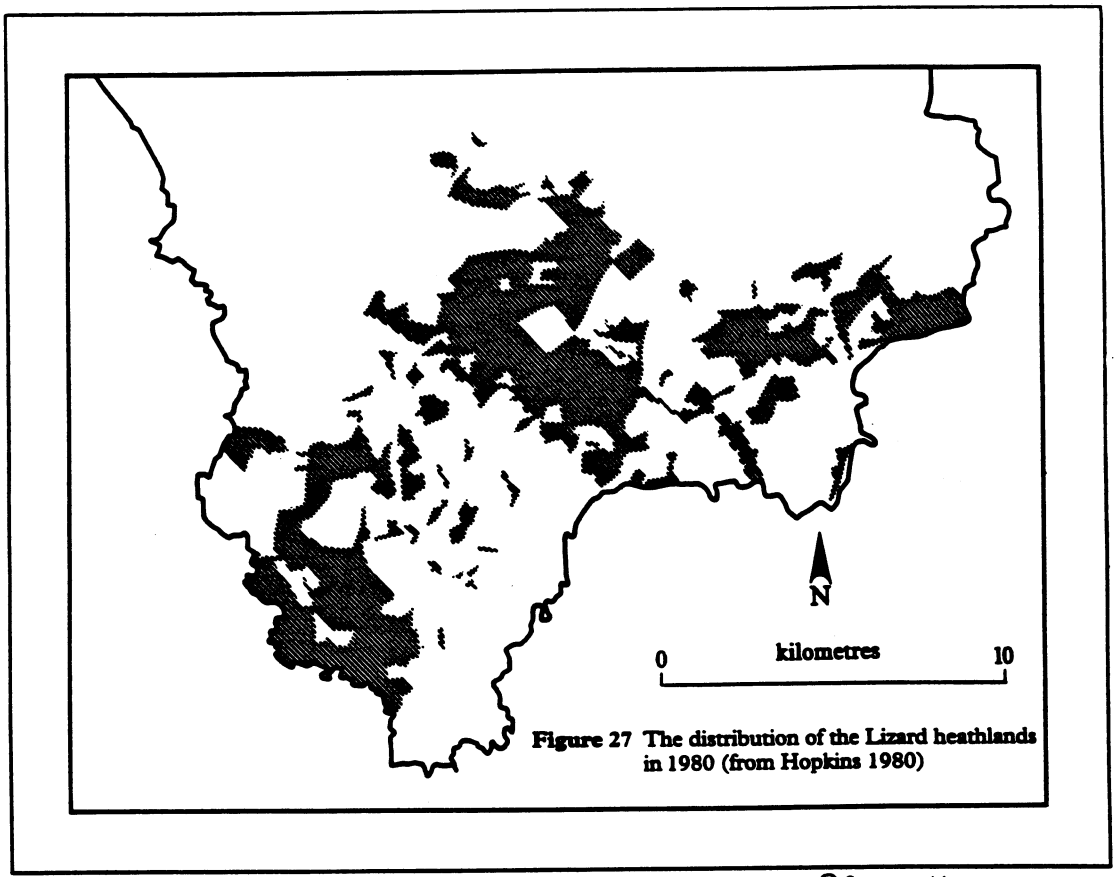


Figure 27 The distribution of the Lizard heathlands in 1980 (from Hopkins 1980)

TABLE 17 **Land uses to which the Lizard heaths have been lost between 1908 and 1980 (for sources see Table 16)**

Land use	Area in hectares
Pasture/arable	735
Military	150
Forestry	120
Telecommunications	105
Other	30

Heathland in the West Midlands has never been extensive. The three remaining large areas, the Stiperstones, Cannock Chase and Hartlebury Common have not suffered unduly from destruction, but rather from recreational pressures and a decline in grazing pressure. These sites are separated from each other by distances of over 30 miles. They are essentially different in character. This may be due to the degree of isolation both from each other and from other large blocks of heathland.

In central England heath may never have been extensive, and today few examples remain. Mid-Wales also has little lowland heath, although both Dyfed and Gwynedd, in the south and north respectively, still hold some excellent examples, mainly of wet heath. Much of the common land in Pembrokeshire is wet heath, little changed this century. In Ceredigion the 'rhos' is a wet grass/heath mixture, peculiar to this part of the country. Agricultural reclamation has reduced its extent in the last 40 years. Such reclamation has also accounted for the loss of Anglesey heath such as Cwmistir Heath in the 1970s (Blackstock & Day 1985).

The east/west pattern of dry/wet heath is continued into Scotland. Lowland heath is mainly restricted in the west to coastal areas and islands such as Lochaber and Coll. In central areas the predominantly mountainous nature of the country precludes lowland heath, and the few examples that are present are on esker ridges or on river valley gravels. Further east there are more extensive areas, often contiguous with upland or coastal communities such as the Muir of Dinnet and Tentsmuir. In some areas such as Banff and Buchan the rich soil has been extensively cultivated since the Second World War and only isolated patches of heath remain in steep-sided valleys not suitable for ploughing. In the extreme north, and on Orkney and Shetland, heathland is one of the dominant vegetation types, and has gradually developed on the shallow soils under the influences of the maritime climate and sheep and cattle grazing.

LOWLAND HEATHLAND IN THE 1990s

There are approximately 60,000 ha of lowland heathland left in Britain (Table 18). Over half of this is in England, with the larger portions being in Hampshire, Dorset, Cornwall, the Breckland, Surrey, Staffordshire and Devon. The two most significant areas in Wales are Pembrokeshire, in Dyfed, and Gwynedd. In Scotland there are few extensive lowland heaths, but often areas exist which have a lowland skirt and then a transition zone into what is predominantly an upland site.

Much of the remaining heathland exists as fragments of previously continuous tracts, as isolated sites, or in narrow, coastal strips. The most comprehensive evidence of fragmentation is from Dorset (see above).

The ecological effects of increased isolation due to reduction and fragmentation of lowland heathland have been examined by Moore (1962). His hypothesis was that the isolation of heathland blocks leads to impoverishment of the fauna. He considered four species that are confined to heathland and four that are also found in surrounding habitats. The true heathland species were absent from the isolated areas, whilst the more flexible species still remained both in the isolated heaths and in the central areas (Figure 28).

TABLE 18 **Extent of lowland heathland with at least 10% cover of heather in Britain in the 1990s. Source: English Nature Lowland Heath Database, all figures are provisional and may be underestimates, particularly in Scotland**

County	Area (ha)
ENGLAND	
Avon	5
Bedfordshire	35
Berkshire	293
Buckinghamshire	86
Cambridgeshire	0
Cheshire	64
Cornwall	6,416
Cumbria	787
Derbyshire	115
Devon	1,589
Dorset	5,365
Durham	48
East Sussex	388
Essex	5
Gloucestershire	15
Greater London	0
Hampshire	9,021
Hereford & Worcester	138
Hertfordshire	16
Humberside	94
Isle of Wight	34
Kent	58
Lancashire	0
Leicestershire	31
Lincolnshire	37
Merseyside	133
Norfolk	537

Table 18 (continued)

County	Area (ha)
ENGLAND	
North Yorkshire	293
Northamptonshire	0
Northumberland	0
Nottinghamshire	43
Oxfordshire	78
Scilly	7
Shropshire	228
Somerset	382
South Yorkshire	0
Staffordshire	880
Suffolk	942
Surrey	2,988
Warwickshire	12
West Midlands	298
West Sussex	205
West Yorkshire	16
Wiltshire	12
TOTAL	**31,694**
SCOTLAND	
	Area (ha)
Aberdeen	385
Angus	1,987
Argyll & Bute	433
Ayrshire & Arran	0
Badenoch & Strathspey	317
Banff & Buchan	301
Bearsden & Milnagivie	0
Borders	0

Table 18 (continued)

SCOTLAND	
	Area (ha)
Caithness	607
Clackmannan	15
Clyde Valley	0
Clydebank	0
Cumbernauld & Kilsyth	0
Dumbarton	0
Dumfries & Galloway	512
Dundee	0
Dunfermline	130
East Lothian	0
Glasgow	0
Gordon	461
Inverclyde	0
Inverness	2,706
Islay & Jura	0
Kincardine & Deeside	470
Lochaber	724
Moray	150
Nairn	0
North Argyll	0
North East Fife	41
Orkney	1,478
Perth & Kinross	67
Renfrew	0
Ross & Cromarty	1,153
Shetland	5,279
Skye & Lochalsh	105
South Argyll	0

Table 18 (continued)

SCOTLAND	
	Area (ha)
Strathkelvin	0
Sutherland	1,037
West Lothian	6
Western Isles	524
TOTAL	**18,888**

WALES	
	Area (ha)
Clwyd	133
Dyfed (Carmathen)	174
Dyfed (Ceredigion)	129
Dyfed (Preseli)	1,370
Gwent	1
Gwynedd	2,725
Mid Glamorgan	1
Powys	415
West Glamorgan	2,504
TOTAL	**7,452**

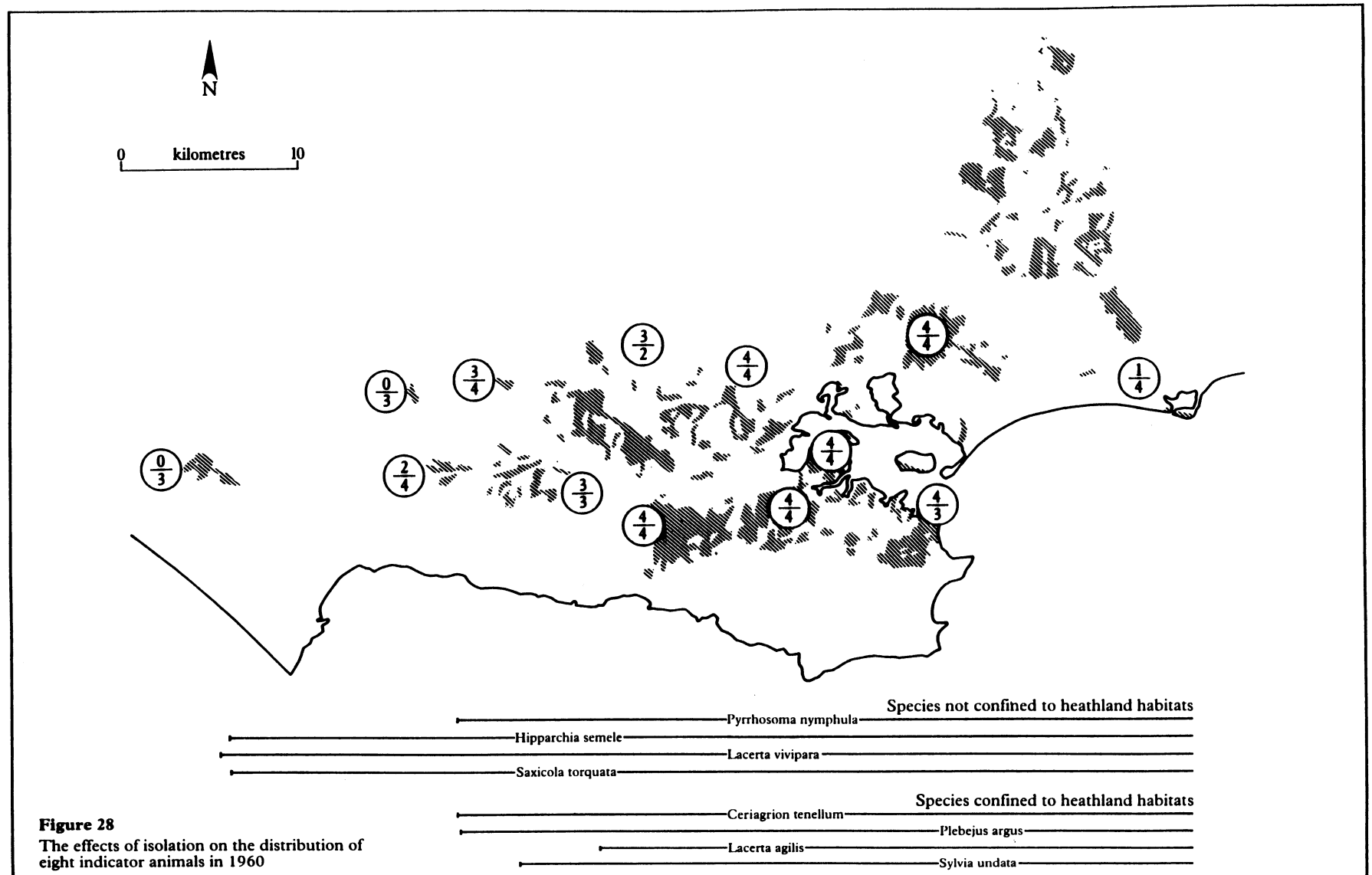


Figure 28

The effects of isolation on the distribution of eight indicator animals in 1960

The figures show the number of species observed in the area indicated. In each case the top figure refers to species confined to heathland habitats, the lower figure to species which are found in other habitats as well (from Moore 1962)

Invertebrate studies on the Dorset heaths have revealed that the situation is complex. Webb & Hopkins (1984) sampled 22 mature, dry *Calluna* heaths. The general trend was that species richness was least on the largest areas. They attribute this probably to the combined effects of isolation and succession. Isolated, small areas have faunas apparently influenced by species straying in from surrounding areas (which are not heathland and have a richer fauna). Succession may also be more rapid on small heaths than on large because of the varied nature of their surroundings and the absence of factors arresting the succession. They conclude that species richness cannot be used as the sole criterion for selecting heathland reserves unless a set of species can be defined which are representative of heathland. However, having defined a set of heathland spiders, the species richness and importance of this group were found to increase with increasing area (Hopkins & Webb 1984). These spiders appear to be restricted to the larger heathlands by their poorer dispersal abilities and persist for longer on the larger heaths than on the small. On small heaths the population sizes may be smaller, so that the risk of extinction is greater. In choosing reserves, therefore, a small area may be suitable if the principal criterion is species richness; but, if representativeness or typicalness is the criterion, a larger area should be chosen as it is more likely to contain a typical heathland invertebrate fauna which is least affected by the surroundings.

SUMMARY AND CONCLUSION

The area of British lowland heathland has declined, but still remains significant in a European context. The decline of lowland heathland in other European countries has also been rapid during the last century. In Sweden and Denmark 60-70% of heathland was lost between 1860 and 1960 (Gimingham, in Specht 1981). Since then more heaths have disappeared and only areas in reserves, or small fragments, now exist (13,575 ha in Danish reserves). In north-west France the situation is similar (Nicholson 1979), with an estimated total of 14,396 ha of heathland surviving. Agricultural reclamation appears to be proceeding at a faster pace than in Britain; sites reported by Nicholson (1979) had disappeared by 1983 (Farrell, pers. obs.). In northern Spain the heaths of the Cantabria and Basque regions are particularly rich botanically, having some 12 species of Ericaceae and 15 species of *Genista*. Sheep and goat grazing were widespread until the 1940s. By 1969 they had declined (Noirfalise & Vanesse 1976) and major afforestation schemes were in hand, using maritime pine and eucalyptus. In western France, afforestation with maritime pine and Scots pine has been carried out on a large scale in Aquitaine, both on the coastal dune heaths and in the inland regions. In 1955 some 200,000 ha of heath remained - approximately one third of the heathland that existed in 1770 (Noirfalise & Vannesse 1976). Less than a century ago the Belgo-Dutch Campine was covered by vast tracts of heath. This has been reduced by about 90%, mainly by afforestation, agricultural clearance, and industrial and urban growth. Aerial pollution from non-ferrous metallurgical industrial plants has totally destroyed some areas (Noirfalise & Vannesse 1976). Again, the remaining areas are mostly in nature reserves (1,500 ha) and military camps. On the North German plain large areas of gorse and heather existed in the 1850s. Afforestation, agricultural clearance and military activities have destroyed most of them. Friesian coastal heaths have been severely affected by tourism. About 7,000 ha remained in 1970.

The British heaths are part of these western European Atlantic heaths, a type of heathland not found elsewhere in the world. The Armorican heath of Cornwall and Dorset has similarities with areas in north-west France where western gorse *Ulex gallii* and Dorset heath *Erica ciliaris* also occur. Dune heath of the type found in Scotland, with crowberry *Empetrum nigrum*, creeping willow *Salix repens* and bearberry *Arctostaphylos uva-ursi*, is also found in Holland, Germany and Denmark. The Anglo-Norman heath characterised by bell heather *Erica cinerea* and dwarf gorse *Ulex minor* occurs on both sides of the English Channel in south-east England and in Normandy and the Paris basin. Compared with the area of these types of heath in Europe in the 1880s, very little remains. It is especially important that examples are retained in Britain as many species reach their western limit here.

Britain has a wide range, and particularly good examples, of wet and humid heathland because our climate is more oceanic than that of much of Europe. These examples are located chiefly in the west, stretching from Cornwall to the Western Isles. Orkney and Shetland, in the extreme north, still retain stretches of maritime heath. The wet heath mosaics of Pembrokeshire and Ceredigion are unique.

The importance of heathland conservation in Europe was recognised in the 1970s when a European Heathland Working Group was set up. Heaths were the first habitat to be considered in this way. This resulted in the Council of Europe's publication on Heathlands of Western Europe (Noirfalise & Vannesse 1976). Subsequently the Council of Europe recognised the ecological significance of this habitat by passing a resolution on the conservation and management of heathlands (Resolution (77)5). In 1979 a European Working Party on Heathlands met to prepare a phytosociological classification of heathlands and to draw up a network of biogenetic reserves. This was intended to establish which were the most important heathlands in Europe and to provide them with further protection. It has resulted in the listing of 12 sites in Britain with a further eight recommended for addition (Farrell 1989).

In the past the main losses of heaths have been to agricultural reclamation and afforestation. Since the Second World War, urban development, mineral workings and clay extraction have increased. Many new roads and motorways have been built, often crossing heaths because the land is open, easily developed, generally well-drained and of low agricultural value and therefore not expensive to buy. For example, the M3 motorway crosses Chobham Common. The development of scrub and woodland, due mainly to a decrease in grazing over the past 40 years and the devastating effect of myxomatosis since the 1950s, has changed many of the open heath landscapes such as in Surrey and Breckland. Today many heaths are used for motorbike scrambling, military manoeuvres and horse-riding. The heaths will withstand some pressure from these activities, but heavy usage is totally destructive of the vegetation cover. A summary of current threats is given in Table 19 (Gillham 1980).

Many of the remaining heaths both in Britain and in other European countries are now in nature reserves. However, heathland is a semi-natural habitat and is as much in need of appropriate management today as much as it was in the past. At present the main threats to remaining heathland are from development, conversion to farmland and a lack of management leading eventually to succession to woodland. Effective site safeguard and the positive management of heathland are essential if further losses of this habitat are to be avoided. It may also be possible to re-create lowland heathland on suitable soil types.

TABLE 19 Summary of current threats to heathland in Britain (Gillham 1980)

Threat	Main locations	Major effects
Agricultural improvement	Uplands, eg Exmoor	Permanent habitat loss
Commercial softwood production	Heaths of S England and uplands of Wales and Northern Britain	Fragmentation and permanent habitat loss
Urban development	Lowland heaths, S England	Fragmentation and permanent habitat loss
Ministry of Defence use	Especially S England	Disturbance and temporary (?) damage to habitat
Recreational and amenity use	Especially S England	Slight to severe localised damage
Severe fire	S England, Staffordshire, N Yorks Moors etc	Fragmentation, disturbance and permanent (?) habitat loss
Pipeline installation	Especially N Britain and Dorset	Temporary or permanent damage to habitat and landscape
Highway construction	Throughout Britain	Habitat damage and loss
Power industry, eg oil, electricity generation	NE Scotland, Dorset, uplands	Varying degrees of damage and habitat loss
Mineral extraction	Throughout Britain, eg SW England (clays), S England (alluvial deposits), N Yorks (potash), etc	Extensive areas of habitat loss with associated areas of damage
Management changes	Marginal and common land	Successional changes in plant and animal communities; loss of habitat

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