Patterns in Archaeological Monument Loss in East Central Scotland Since 1850

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Abstract

The Monuments at Risk Survey 1995 (MARS) outlined rates and causes of identified monument loss in England, showing that 16% of recorded monuments had been completely destroyed by 1995, and that 95% of surviving monuments in England had suffered partial destruction. Hitherto, no equivalent research has been undertaken in Scotland. Using a 17% random stratified sample of 779 field monuments surviving in 1850 within a study area encompassing much of the local authority areas of Perth and Kinross, Fife and Angus, the present research has analysed the distribution and quantified loss of archaeological monuments since 1850 in relation to a number of variables including land use, Land Capability for Agriculture, elevation, local authority area, monument period and material construction.

Results show that monument distribution within the study area varies most noticeably according to land use and elevation. The highest densities of extant monuments are found in semi-natural woodland (17.2 extant sample monuments per 100 km^2) and non-intensive land uses such as unimproved grazing and moorland (13.8 extant sample monuments per 100 km^2). The lowest density of extant monuments is found in arable and improved pasture (4.5 extant sample monuments per 100 km^2), although this is offset by a recorded density of 11.5 cropmark sample monuments per 100 km^2. By elevation, monument densities are highest below 100m OD (24.4 monuments per 100 km^2) and between 250m OD and 400m OD (21 monuments per 100 km^2), with a pronounced paucity of recorded monuments between 100m OD and 200m OD, particularly on improved and arable land.

For each sample monument, a condition history has been constructed through a desk-based study using data from the National Monuments Record of Scotland. This desk-based study has recorded the greatest causes of monument loss since 1850 as unknown causes (28% of loss), archaeological excavation (24% of loss), farming (15% of loss) and development (11% of loss). The monument condition histories created through the desk-based study have then been augmented and calibrated for a sub-sample of 258 monuments by means of an accuracy assessment, using information from vertical and oblique aerial photographs, survey reports from Historic Scotland Monument Wardens and a programme of field survey. Using these additional data sources, the accuracy assessment has identified the largest causes of monument loss within the study area since 1850 as forestry (31% of loss), farming (28% of loss) and development (12% of loss). Analysis shows that among monuments extant in 1850, a minimum of 38% have been reduced in extent, with at least 5% destroyed. Loss has been greatest among monuments found in arable and improved land (39% reduced, 27% destroyed), forestry (79% reduced, 9% destroyed) and developed land (63% reduced, 27% destroyed), and lowest among monuments found in permanent pasture (91% undamaged), semi-natural woodland (75% undamaged) and rough grazing and moorland (85% undamaged).

Although the use of a desk-based study and accuracy assessment has proved successful in identifying trends in the loss of visible monuments, it has been necessary to employ alternative methods by which to assess damage at buried monuments represented by cropmarks. To this end, a programme of excavation, topographic survey and soil depth recording has been undertaken at five locations in Perth and Kinross. Analysis of the results from this programme of excavation and survey has identified statistically significant relationships between land surface curvature and topsoil depth at three of the five sites examined, enabling the mapping at site scale of areas which are likely to have been subject to greatest agricultural damage. Extrapolating from these site-specific maps, it has been possible to map probable damage and risk to cropmark monuments at a regional scale. Although the validity of this regional scale mapping has been limited by the 25m cell size of the digital terrain model on which it has been based, the potential of such a technique in enabling a rapid preliminary assessment of damage and risk to cropmark monuments has been demonstrated.

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Chapter 1

1. The threatened archaeological resource

1.1 Introduction

Scotland's archaeological resource reflects approximately 9000 years of continuous human occupation. This record is diverse in its range of material construction, and is found in fragments ranging in size from preserved landscapes containing any variety of individual features and covering several square kilometres, down to individual artefacts. Over the past century or so, there has been increasing recognition of archaeological data as a finite resource, and the need to protect this resource. Many historical and ongoing processes, both natural and anthropogenic, have contributed to a gradual loss of the archaeological resource. Although many of these processes are well documented, understanding of their precise impacts on archaeological remains is often limited, and the effects of these impacts are seldom quantifiable. Until recently, little systematic research had been undertaken in Britain to quantify the precise impacts of these events and processes. This situation changed, however, with the publication in 1998 of *MARS: The Monuments at Risk Survey of England 1995* (Darvill and Fulton 1998). Commissioned by English Heritage and undertaken from the School of Conservation Sciences at Bournemouth University in association with the Royal Commission on the Historical Monuments of England (RCHME), MARS was the first census of England's archaeological resource, and was designed to fulfil two primary aims. Firstly, it aimed to provide a general picture of the survival and condition of England's archaeological monuments, and secondly, it sought to set benchmarks against which future changes could be monitored (ibid, xix). MARS concluded that '...while there are positive aspects to the current condition and survival of archaeological monuments, for example their visibility and accessibility, the overall picture is bleak' (ibid.). Various results produced through MARS are outlined and discussed later in this document, but the basic figures presented in the preliminary summery of the main report are worth describing here, if only to illustrate the scale and nature of recent loss among archaeological monuments in England.
MARS found that:

1. 16% of recorded monuments had been completely destroyed by 1995, 8% since 1945.
2. 95% of surviving monuments had suffered partial ('piecemeal') destruction.
3. 80% of monument loss could be attributed to five processes. These were agriculture, urbanisation and development, mineral extraction, demolition and buildings works, and road construction.

(Darvill and Fulton 1998, xix).

In addition to highlighting the scale of recent destruction among England's monuments, these figures demonstrate that human activity has been at the root of at least 80% of all recorded monument loss in England.

More recently, a comprehensive study was undertaken for the Department for Environment, Food and Rural Affairs by Oxford Archaeology (formerly Oxford Archaeological Unit) in conjunction with the Council for British Archaeology, Oxford University and Reading Archaeological Consultants (Oxford Archaeology 2002), examining specific issues relating to field monuments in the arable landscape. The project, entitled *The Management of Archaeological Sites in Arable Landscapes*, was designed to "... establish the basis for developing a management strategy for preserving archaeological sites on arable land that will focus on where damage is most serious and will provide sustainable remediation of the problem." (Oxford Archaeology 2002, 1). Thus, the focus of the project was not the quantification of past loss, but on the prediction and mitigation of future loss. The execution of both MARS and the *Management of Archaeological Sites in the Arable Landscape* project demonstrate a concerted effort among archaeologists and resource managers both to identify the scale of monument loss in England and to develop mechanisms by which the archaeological resource might be protected.

In Scotland, no such research has been undertaken. This lack of quantitative research has ensured that estimates of monument loss in Scotland have been crude, based on anecdotal evidence and generalisations, although it has been suggested that an MARS-type archaeological audit in Scotland would be likely to reveal equivalent rates of destruction (Swanson 1991, 4; Berry 2000, 63). In order for curatorial bodies in Scotland to present cogent arguments on behalf of the archaeological resource in policy formulation and other spheres, however, it is necessary to have statistically founded information on rates and causes of loss pertinent to the Scottish archaeological resource. Given the marked regional variations in monument survival identified by MARS (Darvill and Fulton 1998, 114-117, 124), it must be assumed that extrapolation from MARS and other English-based projects to estimate loss rates in Scotland would be crude at best, and at worst, dangerous.

It is timely, therefore, that a quantification of monument loss should be undertaken in Scotland. The present research has achieved this by quantifying archaeological monument loss in eastern central Scotland since 1850 and identifying of the causes of this loss. Funded by Historic Scotland, the research has taken place in conjunction with another post-graduate research student modelling soil erosion at cropmark monuments within the same study area (Bowes 2003), which incorporates parts of the modern Perth and Kinross, Fife, Angus, Stirlingshire, Dundee and Clackmannanshire local authority areas (figure 1.1). Although the broad scope of the research has not enabled detailed analysis of all threats to the archaeological resource, it has been possible to identify and examine general trends in monument loss and their causes. The first of its kind to be undertaken in Scotland, the research examines a number of themes relating to the archaeological record within the study area, beginning with an analysis perceived monument distributions with specific regard to non-archaeological factors which have affected their long-terms survival and detection (chapter 3). The main body of the research has been concerned with the identification, quantification and analysis of trends in monument loss within the study area since 1850 (chapters 4 and 5). These elements of the research have been addressed through a large desk-based study, the results of which have been calibrated by means of a programme of field survey and interrogation of other existing data sources. Because condition of cropmark monuments is difficult to ascertain, however, it has been necessary to employ alternative means, such as excavation and computer modelling, by which to estimate changes in their condition (chapter 6). Although the results of this research fill some gaps in the knowledge and understanding of monument loss in eastern central Scotland, inevitably, they also serve to illustrate how large and numerous these gaps are. In Chapter 7, successes and failures of the methodologies used are discussed, followed by discussion of the implications of the results in ongoing and future archaeological resource management, and the identification of areas where further research is desirable.

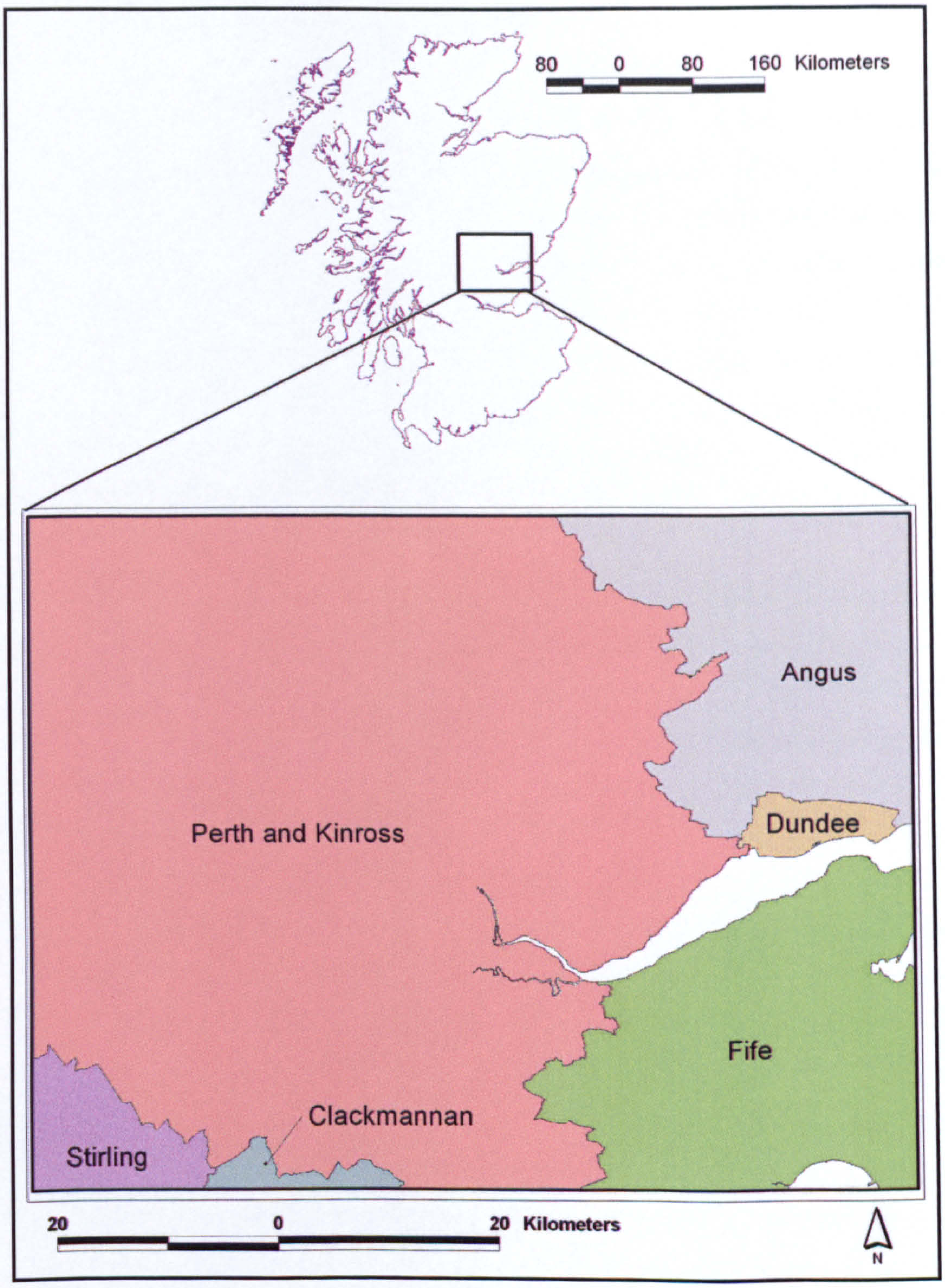

Figure 1.1. Study area location map showing local authority areas included.

In this chapter, issues relating to the survival, management and recording of the archaeological resource are examined. Anthropogenic and natural threats to the archaeological resource are reviewed, and the current structural and legislative framework of British archaeology is described with specific reference to Scotland. First, however, it is necessary to define what is meant by the archaeological resource, and how this resource can be quantified in order to estimate rates of loss and changes in its condition.

1.2 The archaeological resource

Darvill and Fulton provide an all-encompassing definition of the archaeological resource, suggesting that it is part of an original population which consists of "... an unknown and unknowable quantity which represents the sum total of all deposits, structures, monuments and other data that have ever been created or formed and which could potentially be of interest to archaeologists." (Darvill and Fulton 1998, 13). They suggest that the archaeological resource can be defined as the surviving part of this original population that is interesting and relevant to archaeological study, though acknowledging that the defining boundaries of the archaeological resource are fluid, as the definition of what is relevant to archaeological study is constantly evolving (ibid.).

Another term which requires clarification at this stage is the 'historic environment', as this is a term which is increasingly in current archaeological literature. The historic environment is defined in National Planning Policy Guideline 18 (Planning and the Historic Environment) as "... the tangible built heritage – historic buildings and townscapes, parks and gardens, designed landscapes, ancient monuments, archaeological sites and landscapes. It also includes the wider setting of these features and areas as well as places important for their historic associations". (SOED 1999, 5). This acknowledgement of the importance of less tangible elements of the legacy of past human activities (where archaeological material or data might be less easy to define) is taken a stage further in Historic Scotland's policy statement 'Passed to the Future: Historic Scotland's Policy for the Sustainable Management of the Historic Environment', which includes "...historical, artistic, literary, linguistic and scenic associations of places and landscapes." (Historic Scotland 2002, 8). While this definition of the historic environment may neatly encapsulate all that might interest archaeologists, it differs from and is incompatible with Darvill and Fulton's definition of the archaeological resource in one crucial respect. Darvill and Fulton describe "...deposits, structures, monuments and other *data*..." (Darvill and Fulton 1998, 13), whereas definitions of the historic environment extend to include concepts and associations.

In this research, it has been necessary to discard all notions of quantifying non-tangible entities such as historic associations and to concentrate on tangible elements of the archaeological resource. MARS was faced with the same problem, and by necessity, based its findings on visual observations and field inspection (ibid, 10). Similarly, in quantifying loss of the archaeological resource (or historic environment), it has been necessary within this research to confine study to those elements which are both identifiable and which have a perceived finite extent. In practical terms, the most easily identifiable and quantifiable element of the archaeological resource is the discrete building, structure or earthwork, often isolated within the modern landscape, where materials relating to past events or land uses are known to survive. Such elements are commonly referred to as archaeological sites or monuments, though for simplicity, the term 'monument' will be used throughout this document.

By examining the archaeological resource and historic environment in this way (though throughout this document, only the term 'archaeological resource' is used), it is acknowledged that many larger, more complex or less tangible elements of the resource have been excluded from this research. However, given the limits in manpower and resources, and the constraints of the data on which the research has been based (chapter 2), such an approach has been necessary. It is also worth pointing out here that the research has primarily examined monuments in rural settings. The reasons for this are outlined in section 2.4. Although the research has involved a brief examination of monument condition change in relation to monuments legislation and development control, it has been outwith the scope of this research to provide a detailed assessment of the impacts of development on the urban archaeological resource. Instead, the main focus of the research has been on monuments in rural areas and the effects of processes which remain outwith legislative control. Before the discussion of these processes in section 1.4, a brief account of the structure of British (and specifically Scottish) archaeology and archaeological resource management and some of the legislation pertaining to the archaeological resource is discussed in section 1.3. Such is the scale of the subject, however, it has been necessary to limit this discussion only to those areas of archaeological resource management directly relevant to the present research, and no attempt has been made to provide a comprehensive review.

1.3 Archaeological resource management and legislation

Archaeological resource management is now widely recognised as an important sector of modern archaeological practice in the UK (e.g. Darvill 1986; 1987; Hunter and Ralston 1993; Berry and Brown 1994; 1995; Darvill and Fulton 1998; Chitty and Baker 1999; Grenville 1999; Oxford Archaeology 2002). This development has not occurred in isolation, as legislative and administrative mechanisms for the protection of the archaeological resource are now found throughout the world (Cleere 1989; 1993). This is evidenced by literature on the subject pertaining to (among others) Europe (Ashworth and Howard 1999), Australia (Flood 1989), the Far East (Grenville 1996b) Africa (Myles 1989), South America (Norton 1989), Canada (Pearce 1989) and the United States of America (King 1998). As with many other parts of the world, archaeological resource management in the UK has evolved and expanded partly in response to a number of threats. This evolution and expansion has been at its most pronounced over the last 30 years (Hunter and Ralston 1993, 30).

The legislative foundations of British archaeological resource management were created in the late 19th century, which witnessed the passing in UK Parliament of the Ancient Monuments Protection Act of 1882 (Breeze 1993, 44). This Act has since been superseded by eight further pieces of legislation (summarised by Darvill 1987, 3-4), culminating in the current primary article of statutory legislation, the Ancient Monuments and Archaeological Areas Act 1979 (AMAA Act 1979). The AMAA Act 1979 enables central government to compile and maintain a list (known as a schedule) of monuments deemed to be of national importance. In Scotland, the importance of a monument is assessed against eight unranked indicative criteria including survival / condition, period, rarity, fragility / vulnerability and group value (Breeze 1993, 45), though these criteria are currently under review (Barclay, pers. comm.). In Scotland, the responsibility for enforcing the 1979 Act falls upon Historic Scotland, the Scottish Executive agency charged with protection of the built heritage and historic environment. Once scheduled, a monument is afforded statutory protection by the Scottish Ministers (formerly the Secretary of State for Scotland) against development and other potentially damaging activities. Furthermore, the AMAA Act 1979 provides a mechanism through which works affecting a scheduled ancient monument can be controlled (Breeze 1993, 47). Consent must be sought in advance for:

1. Any works resulting in the demolition or destruction of or any damage to a scheduled monument.

2. Any works for the purpose of removing or repairing a scheduled monuments or any part of it or of making any alterations or additions thereto; and
3. Any flooding or tipping operations on land in, on or under which there is a scheduled monument.

The success of the AMAA Act 1979 in aiding monument preservation in England has been demonstrated by MARS, which found that destruction among scheduled earthworks was about 6% compared with 9% among unscheduled earthworks. Among scheduled buildings and structures, about 9% were destroyed, compared with about 19% destroyed among unscheduled buildings and structures (Darvill and Fulton 1998, 199). This disparity in rates of loss between scheduled and unscheduled archaeological remains will also be attributable to the introduction in England in the late 1980s of Planning Policy Guidance notes (PPGs), under which there is a presumption against development that would adversely affect scheduled ancient monuments (Griffiths 1999). In Scotland, the equivalent National Planning policy Guidelines (NPPGs) are thought to have contributed to a paucity of development proposals affecting scheduled ancient monuments (Barber 2003). However, the Ancient Monuments (Class Consents) (Scotland) Order 1996 enables a number of potentially damaging activities to take place at scheduled ancient monuments, including some agricultural, horticultural and forestry works, works for the repair or maintenance of machinery, and works urgently necessary for health and safety (HMSO 1996, 3). The severity of the risk posed to any archaeological monuments by agriculture in particular cannot be underestimated, and has recently been the subject of considerable publicity in England (English Heritage 2003). It is also worth mentioning that there are currently about 7700 scheduled ancient monuments in Scotland. Although this figure is increasing steadily, it is likely to be several decades before every part in Scotland has been subject to a systematic program of scheduling. It has been estimated that the total number of recorded monuments which are likely to meet the criteria for scheduling may range between about 16,500 and 19,500 (Ashmore, pers. comm.), and it is likely that as the area of land in Scotland subjected to systematic archaeological survey increases, so will this figure. This suggests that although many of Scotland's most important monuments are currently statutorily protected under the AMAA Act 1979, a large number of equally important monuments remain unprotected by the Act.

The powers of the AMAA Act 1979 extend beyond scheduling. Under sections 12, 13 and 15 of the Act, a monument can be taken into State Care, with the consent of the owner (Breeze 1993, 48). Furthermore, section 17 of the Act enables the creation of

Management Agreements, under which payments are made for ongoing management works (at scheduled or unscheduled monuments), and section 24 enables the payment of grants for one-off works beneficial to the long-term condition of a monument (ibid.). It is acknowledged that the creation of the AMAA Act 1979 was instrumental in rekindling interest in the preservation of monuments (Darvill 1987, 4). The Act was passed at a time when the rise of the Rescue movement had promoted the recognition of archaeological material as a finite resource to be protected (Hodder 1999, 13), and since its publication, archaeological resource management has seen an expansion to its present state. This expansion can be attributed to a combination of factors, including the introduction of further legislation such as National Planning Policy Guidelines, but as some have pointed out (e.g. Hunter and Ralston 1993; Swanson 1993, 55), the contributions of voluntary agreements, formal agreements, and general co-operation have played a significant role in this expansion. Consequently, while the AMAA Act 1979 remains the principal legislation for the protection of archaeological monuments, a large number of bodies contribute to the ongoing management and protection of the archaeological resource. The involvement of this wide range of organisations in archaeological resource management is well summarised by Hunter and Ralston (1993) and Swanson (2001), but some aspects are worth discussion here.

1.3.1 Central Government

Although the primary function of central government in archaeological resource management is Historic Scotland's implementation of national legislation such as the AMAA Act 1979 and the Planning (Listed Buildings and Conservation Areas) Act 1997 (Swanson 2001, 8), Historic Scotland also provides funds towards archaeological projects, many of which assist with the development of conservation strategies and best practice management regimes. Furthermore, as part of central government, Historic Scotland is charged with some policy formulation, reflected in documents such as the Stirling Charter (Historic Scotland 2000) and *Passed to the Future* (Historic Scotland 2002), which set out the Scottish Executive's policy for sustainable management of the built heritage and historic environment. As part of the Scottish Executive, Historic Scotland is also a statutory consultee in the Environmental Impact Assessment (EIA) process under The Environmental Impact Assessment (Scotland) Regulations 1999 and The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 at both the scoping stage (where views are expressed on the issues that the EIA should address) and at the formal consultation stage after the publication of the Environmental Statement (M Black, pers. comm.). Historic Scotland is also consulted under the Town and Country Planning (General Development Procedure) (Scotland) Amendment (No 2) Order 1994 as it is a statutory requirement for planning authorities to consult Historic Scotland where development proposals may affect the site of a scheduled monument or its setting.

In addition to Historic Scotland, other governmental agencies such as the Forestry Commission and the Scottish Executive Environment and Rural Affairs Department (SEERAD) play an increasing role in the protection and management of the archaeological resource though the implementation of legislation pertaining to forestry (section 1.4.4) and agriculture (section 1.4.3). Macinnes and Ader (1995) have highlighted this increasing cooperation and involvement between governmental organisations, while Swanson (2001, 9) has pointed out the contribution that the Heritage Lottery Fund has made in the repair, refurbishment and conversion of historic buildings.

1.3.2 Local Government

Most of the responsibility for the protection of the archaeological resource lies at local authority level, primarily through development control under the Town and Country Planning (Scotland) Act 1997 and the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997 (Swanson 2001, 10). In the National Planning Policy Guideline on planning and archaeology (NPPG 5) and the historic environment (NPPG 18), the archaeological record is recognised as 'a finite and non-renewable resource' (SOED 1994; 1999). Under current planning legislation, archaeological remains 'should be preserved wherever feasible and ... where this proves not to be possible, procedures should be in place to ensure proper recording before destruction, and subsequent analysis and publication' (SOED 1994, 5). The task of ensuring that these procedures are adhered to falls to regional archaeologists who are employed either directly by local authorities or by independent Trusts through an arrangement with local authorities (Swanson 2001, 10). In addition to development control, regional archaeologists also deal with agri-environment scheme applications and other regulatory processes (ibid.).

The development of curatorial services in Scotland has taken place at a much slower rate than in England (Baker and Shepherd 1993; Barclay, pers. comm.). By 1980, only three of the twelve Scottish regional authorities had regional archaeologist posts, though these were followed by four further authorities in the late 1980s (Baker and

Shepherd 1993, 111). By the time of regional authority re-structuring in 1995, Lothian, Tayside and the Western Isles were still without a regional archaeologist. The most recent creations of local authority archaeologist posts in Scotland have been in Perth and Kinross and East Lothian (both within the last four years), but a number of local authorities remain without the curatorial services of an archaeologist. The sites and monuments records (SMRs) which regional archaeologists maintain are key tools in development control, but neither the appointment of a regional archaeologist nor the maintenance of an SMR is a statutory obligation. Swanson (2000) has pointed out that as long as council archaeological services are non-statutory, they will remain a soft target for cuts when authority finances are stretched.

In keeping with local authority archaeologists posts, SMRs have developed more slowly in Scotland than in England (Historic Environment Conservation 1999, 1; Barclay, pers. comm.), and several local authorities in Scotland still have no archaeologist or SMR. Furthermore, a number of local authority archaeological services are provided from other, usually adjacent local authority areas. This is most pronounced in the west of Scotland, where the West of Scotland Archaeology Service (WoSAS) provides archaeological services to no fewer than twelve local authority areas. In the east, the local authorities of Angus and Buchan are curated from Aberdeenshire. A number of writers have called for the appointment of an archaeologist and the maintenance of an SMR to become a statutory obligation for local authorities (Historic Environment Conservation 1991; Frew 2000) with additional funding from central Government if necessary to ensure that they meet a minimum standard of content and service delivery (APPAG 2003). Until this occurs, however, the potential for the removal or reduction of specialist archaeological input to the planning process in response to funding shortages remains.

1.3.4 Archaeological survey and record

The identification of monuments and the accessibility of information relating to their position and spatial extent is key in securing their preservation (Breeze 1989, Yarnell 2003). In Scotland, the bulk of archaeological survey is carried out by the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS). Like its counterpart organisations in England and Wales, RCAHMS was created in 1908 with the remit of compiling an inventory of the ancient and historical monuments of Scotland, specifying which of these were most worthy of preservation (Fraser 1993, 23). For the greater part of the 20th century, RCAHMS concentrated on the publication of Inventories based on detailed field survey carried out by RCAHMS investigators (ibid.), but in the 1980s the focus began to change towards rapid identification of new monuments, and recent publications (e.g. RCAHMS 1990; 1994) have included a considerable degree of synthesis. RCAHMS maintains the National Monuments Record of Scotland (NMRS), a centrally curated database of records pertaining to the built heritage. Although many of the records in the NMRS refer to field monuments, a large number refer to artefact find spots, and large numbers of occupied buildings have been included in the database in recent years. The NMRS also incorporates the Scottish archives of the former Ordnance Survey Archaeology Division and archives relating to excavations (Fraser 1993, 23).

Although the NMRS has been identified as the most comprehensive database of archaeological monuments in Scotland (Murray 1992, 210), development control is based on the locally curated SMRs. Most of the information held in SMRs within the study area (Perth and Kinross, Fife, Angus, Stirlingshire and Clackmannanshire) is derived directly from the NMRS (D Strachan, T Rees, M Greig, L Main, pers. comm.). No further British SMRs have been examined as part of this research, and so it is not clear to what extent SMRs elsewhere in the UK have developed their own structure and data. Although SMRs are used for development control, large numbers of archaeological monuments remain unrecorded as not all parts of Scotland have been systematically surveyed. Recent RCAHMS surveys (e.g. Cowley 1997; Cowley 2003; Hale 2003) demonstrate the possible extent of unrecorded archaeological remains in areas where systematic survey has not yet been conducted. Such remains are vulnerable to unrecorded damage or destruction by virtue of the fact that they are unrecorded. Although in many instances local authority archaeologists might stipulate a walk-over survey or trial trenching in advance of a decision on an application for planning permission, as recommended in Planning Advice Note 42 *Archaeology – The*

Planning Process and Scheduled Monument Procedures (SOED 1994), where there are no existing records of archaeological remains, such conditions are less likely to be triggered. However, professional archaeological interpretation of the known records that are held by an SMR can result in an assessment of an area's potential for presently unknown archaeological remains, usually as an advance desk-based assessment and / or a field evaluation (M Black, pers. comm.).

1.4 Threats to the archaeological resource

The brief outline of archaeological resource management and legislation in Britain (and Scotland in particular) presented in section 1.3 provides a backdrop against which an assessment of many of the threats to the archaeological resource can be assessed. In this section, many of these threats are outlined, and although some of these threats can be controlled or limited through legislation, the majority cannot. Irrespective of whether damaging processes can be controlled through legislation, the vast majority of threats to the archaeological resource are anthropogenic in origin.

1.4.1 Development, archaeological excavation other anthropogenic threats

Probably the most widely recognised threat to the archaeological resource is that posed by development. Many types of development, such as mineral extraction, housing and road building, involve the movement of large quantities of earth, and have the potential to cause widespread disturbance, truncation or destruction of archaeological features. Development can also create changes in drainage and hydrology, leading to desiccation of waterlogged deposits and any preserved organic material they might contain. MARS found that development and urbanisation were responsible for 27% of observed cases of monument destruction and 9% of piecemeal monument loss among monuments in England. Road building accounted for a further 9% of destruction and 4% of piecemeal loss. Mineral extraction accounted for 12% of observed destruction and 2% of monument damage (Darvill and Fulton 1998). As shown in section 1.3, planning legislation in Scotland now states that archaeological remains 'should be preserved wherever feasible and ... where this proves not to be possible, procedures should be in place to ensure proper recording before destruction, and subsequent analysis and publication' (SOED 1994, 1999). While this helps ensure the protection or recording of archaeological remains before destruction, some studies (e.g. Darvill and Russell 2002; O' Sullivan 2001; Swanson 2001) highlight the considerable growth in developer-funded excavations with the development of UK planning legislation. In England, 89% of all archaeological interventions between 1990 and 1999 were prompted by the planning process and development control (Darvill and Russell 2002, 52). In the same space of time, there was a three-fold increase in the number of archaeological excavations in England, largely caused by the increase in archaeological interventions precipitated by the development of planning policies. Because of this tie between development and archaeological excavation, they are discussed together here.

Government support for rescue archaeology started during the Second World War, when resources were provided for the excavation of monuments threatened by wartime development (Thomas 1993, 137). This support continued into the 1950s and 60s, during which time rescue excavations were carried out by the Ministry of Works (usually aided by volunteers or paid labourers) or by local committees (ibid.). In the late 1960s and early 1970s, there was an increase in concern about the loss of archaeological sites through development. Government funding began to increase, and many local trusts and support organisations were established. Such bodies derived the bulk of their funding from Department of the Environment grants (ibid.). Although state-funded rescue archaeology saw a marked increase in Scotland through the 1970s, the scale of government expenditure on excavation during this period remained markedly lower in Scotland than in England. In 1973/4, government expenditure on excavation in Scotland was £22,500 while in England, this figure stood at £715,644. By 1977/8, the Scottish figure had risen to £142,000 while English expenditure stood at £1,890,000 (Barclay and Owen 1995, 4). As outlined in section 1.3.3, into the late 1980s and early 1990s, the contribution of developer funding in archaeological excavation increased as new planning controls were introduced, (Hunter and Ralston 1993, 35; Lawson 1993, 150). These changes in funding for archaeological excavation are clearly demonstrated in studies such as Sherriff (2000), which has outlined archaeological excavation in Perthshire between 1948 and 1998, illustrating the sharp increase in rescue excavation in the 1970s followed by further rescue work and developer funding in the 1980s and 1990s. The current dominance of developer funding in archaeological excavation within the study area is reflected further in the *Tayside and Fife Archaeological Journal,* recent editions of which contain reports on excavations in advance of mining operations and mineral extraction (e.g. Murray and Ralston 1997; Stewart *et al.* 1999; Halliday 2002; Cameron 2002;), road building (e.g. Neighbour 1998) and pipelines (e.g. MacGregor 1998; James and Duffy 2001).

Although archaeological excavation remains a highly destructive process, it is vital for the furthering of understanding of the archaeological resource. Indeed, Grenville (1996a) has suggested that a continued emphasis on in situ preservation threatens to cause stagnation in the archaeological profession. It is worth considering, therefore, why in situ preservation should be considered preferable to archaeological excavation, given archaeology's dependence on excavation. Grenville argues that a preference for in situ preservation came to the fore in the 1970s and 80s as archaeologists came to recognise that in the pursuit of archaeological deposits that were the focus of specific research objectives, deeper or adjacent archaeological material had been destroyed without record (ibid, 10). Secondly, it was (and is) felt that future generations will have improved techniques with which the finite data could be analysed. Grenville has also pointed out that failure to publish excavation results has meant that effectively, many deposits have been destroyed without record.

Darvill and Russell (2002, 53) have pointed out that archaeology being heavily reliant on developer funding means that external economics such as boom and bust phases in the property industry can directly affect levels of employment and archaeological activity. Furthermore, some developer funded excavations are carried out to very tight schedules, which will inevitably reduce the quality of information retrieval or force the continuation of excavations during inappropriate weather or ground conditions (e.g. Halliday 2002). Grenville (1996, 12) and Lawson (1993, 150) have argued that developer funding has created biases in the sample of sites excavated, ensuring that some research strategies have been driven by enforced, non-academic aims. Conversely, Darvill and Russell have suggested that developer funding may benefit archaeological research by introducing an element of random sampling in archaeological investigations, as development is governed by external factors rather than by preconceived research objectives among archaeologists (Darvill and Russell 2002, 53). Development has also been regarded as being potentially positive in furthering knowledge about monument distributions, with Barrett *et al.* (1992) citing road construction as a means of stripping large areas of topsoil in which previously unknown archaeology might be discovered.

Other processes detrimental to the archaeological resource that might be controlled through planning legislation include demolition, building renovation and re-utilisation. MARS found that 20% of wholesale monument loss was attributable to demolition and building alteration. Demolition accounted for 5% of piecemeal loss and building alteration for 11%. Indeed, MARS showed also that about a third of all damage to archaeological monuments could be attributed to causes which could be controlled though the planning system (Darvill and Fulton 1998, 237). In Scotland, Swanson (1993) identified development as one of key threats to Medieval or Later Rural Settlements (MoLRS) within the former Strathclyde Regional Authority area, particularly through their development as second or holiday homes.

1.4.2 Farming

Agricultural activities, particularly those associated with arable production, are widely recognised by archaeologists as being among the most significant threats to archaeological monuments (e.g. Hinchcliffe and Schadla-Hall 1980; Darvill 1987; Berry 1994; Macinnes 1997; Wordsworth 1999; Oxford Archaeology 2002; English Heritage 2003). MARS found that arable agriculture accounted for approximately 10% of observed cases of monument destruction and about 30% of observed cases of monument damage in England from 1945 to 1995 (Darvill and Fulton 1998). Despite the well documented negative impact of farming on the archaeological resource, farming operations remain outwith the control of planning legislation. As a result, monuments in agricultural land (particularly unscheduled monuments) remain extremely vulnerable to damage (Dormor 1996; Wordsworth 2002). The types of damage to monuments caused by farming and farming-related activities vary greatly, ranging from deep ploughing, seedbed preparation and the planting of root crops (e.g. Halkon 2001) in arable areas, to vehicle damage, quarrying and stone dumping in more marginal areas (Macinnes 1993, 244). Livestock can also cause considerable damage to monuments (e.g. Streeten 1994; Taylor 2001).

1.4.2.1 Arable farming

The negative effects of arable farming on cropmark monuments are discussed in depth in chapter 6, and no attempt is made here to discuss the precise mechanisms of loss among cropmark monuments imposed by intensive modern agriculture. However, many upstanding monuments are affected by ploughing also, and so arable farming is worth discussion here, specifically as it relates to upstanding archaeological remains. Large numbers of studies have demonstrated the negative impacts of agriculture on upstanding monuments. Operations range from the alteration of monument profile through ploughing (e.g. Drewett 1980; French 2001) to the bulldozing of earthworks and standing buildings to make way for ploughing in previously uncultivated areas (e.g. Hinchcliffe 1980; Lawson 1980; Manby 1980; Gingell and Schadla-Hall 1980) or the flattening of earthworks through repeated ploughing (e.g. Canham *et al.* 1980). The ploughing of previously uncultivated areas since the Second World War has seen the destruction of large numbers of monuments in England (Hinchcliffe and Schadla-Hall 1980; Oxford Archaeology 2002). English Heritage (2003) estimates that the area of permanent grassland in England fell by over 600,000 hectares between 1950 and 2001, containing an estimated 14,000 monuments.

Although some authors have noted that ploughing up of previously uncultivated monuments in the south of England began long before the Second World War (e.g. Canham *et al.* 1980; Lawson 1980; Simmons 1980), this trend was greatly accelerated in the second half of the 20th century, and was closely tied to government policy. In 1939, the British government, concerned at a heavy British reliance on imported foodstuffs, introduced extra subsidies for the ploughing up of permanent grass. This contributed to an increase of about 50% in the area ploughed throughout the UK (Holderness 1985, 6), though Agricultural and Horticultural Statistics suggest that the area of tillage achieved during the Second World War never exceeded the total area of tillage recorded in 1871 (MAFF 1968). The intensification of arable farming, encouraged by government subsidies, continued in the post-war years and was accelerated by Britain's entry into the European Economic Community in 1973, at which time British agriculture became controlled by the Common Agricultural Policy (CAP) (Dormor 1996, 15). The CAP provided further financial incentives to farmers for mechanisation and intensification (ibid.). This drive for agricultural production can be detected in literature from the 1970s and 1980s. For example, *Modern Farming and the Soil*, a report by the Agricultural Advisory Council on Soil Structure and Soil Fertility (MAFF 1970) was undertaken at a time when concerns were mounting about the 'flattening graph of increasing yields' (ibid, v). One of report's recommendations was a major drainage campaign (ibid, 109). Fifteen years later, Holderness observed that "in some respects the heritage of the past has been embarrassing, for hedgerows, trees, shallow drains have frequently been obstacles to progress, however great their aesthetic and ecological appeal". (Holderness 1985, 45).

In the mid 1980s, the focus of agriculture began to move away from intensive production and towards environmental management. With the passing of the 1986 Agriculture Act, incentive payments were introduced for sympathetic environmental management, and a voluntary set-aside scheme was introduced, encouraging farmers to fallow land rather than grow unwanted food (Dormor 1996; Macinnes 1993). Environmentally sensitive areas (ESAs) were also introduced through the Act. These constituted designations whereby a wide range of incentive payments became available to farmers in return for the positive management of wildlife habitats and landscape features (Dormor 1996, 15). This shift towards extensification and agri-environmentalism has continued up until the present day. Agri-environment schemes were made compulsory under the McSharry reforms to the CAP in 1992 (Fojut, pers. comm.), and Scotland has seen the introduction of the Countryside Premium Scheme in 1997, which has since been superseded by the Rural Stewardship Scheme. Although the schemes have been targeted primarily at encouraging biodiversity, archaeologists have been quick to note the potential for archaeological remains to benefit from their introduction (e.g. Macinnes 1993; Jago 1995; Dormor 1996; Berry 2001). Payments made under agri-environment schemes in Scotland now total approximately £30,000,000 per annum, compared with about £1,000,000 per annum in the mid-1990s (Fojut, pers. comm.). A further round of CAP reforms is currently under discussion. This will see the introduction of a number of cross-compliances, linking farm payments to environmental requirements on the part of farmers (SAC 2003). It is not yet known if these cross-compliances will include provisions for the archaeological resource.

Although agricultural damage to the archaeological resource saw a sharp increase in the second half of the 20th century, recognition of the detrimental effects of agriculture on the archaeological resource is not a solely modern phenomenon. Within the study area of this research, an early example of archaeological intervention in response to agriculture is noted in the Statistical Account of 1793, where it is recorded that William Stirling, the proprietor of Ardoch Roman Fort near Braco in Perthshire (NMRS no. NN80NW 10) had "...enclosed (the fort) with a high stone wall, that it may never again suffer by a ploughshare. He has also prohibited the tenants from plowing up, or otherwise demolishing, any part of the remaining lines or ramparts round the two larger camps." (Statistical Account of Scotland 1793, 495; Christison *et al.* 1897, 426). Through this intervention, Stirling helped ensure that the fort at Ardoch remains one of the best-preserved Flavian period Roman earthwork forts in Britain (figure 1.2). His recognition of the negative effects of agriculture on the archaeological resource was not unique at this time. Also in the 18th century, Robert Melville, in attempting to find evidence of Roman antiquities in Strathmore, Perthshire, made ..."enquiries and searches, especially in heaths and uncultivated places." (Stuart 1870, 29), suggesting that even in the 1750s, detection of earthworks was necessarily directed towards uncultivated ground. In mapping Roman sites in the 1750s and 60s, William Roy himself is known to have commented to the same effect (RCAHMS 1994, 4), and many of Roy's maps show partial earthwork survival attributable to agriculture at this early date (Roy 1793).

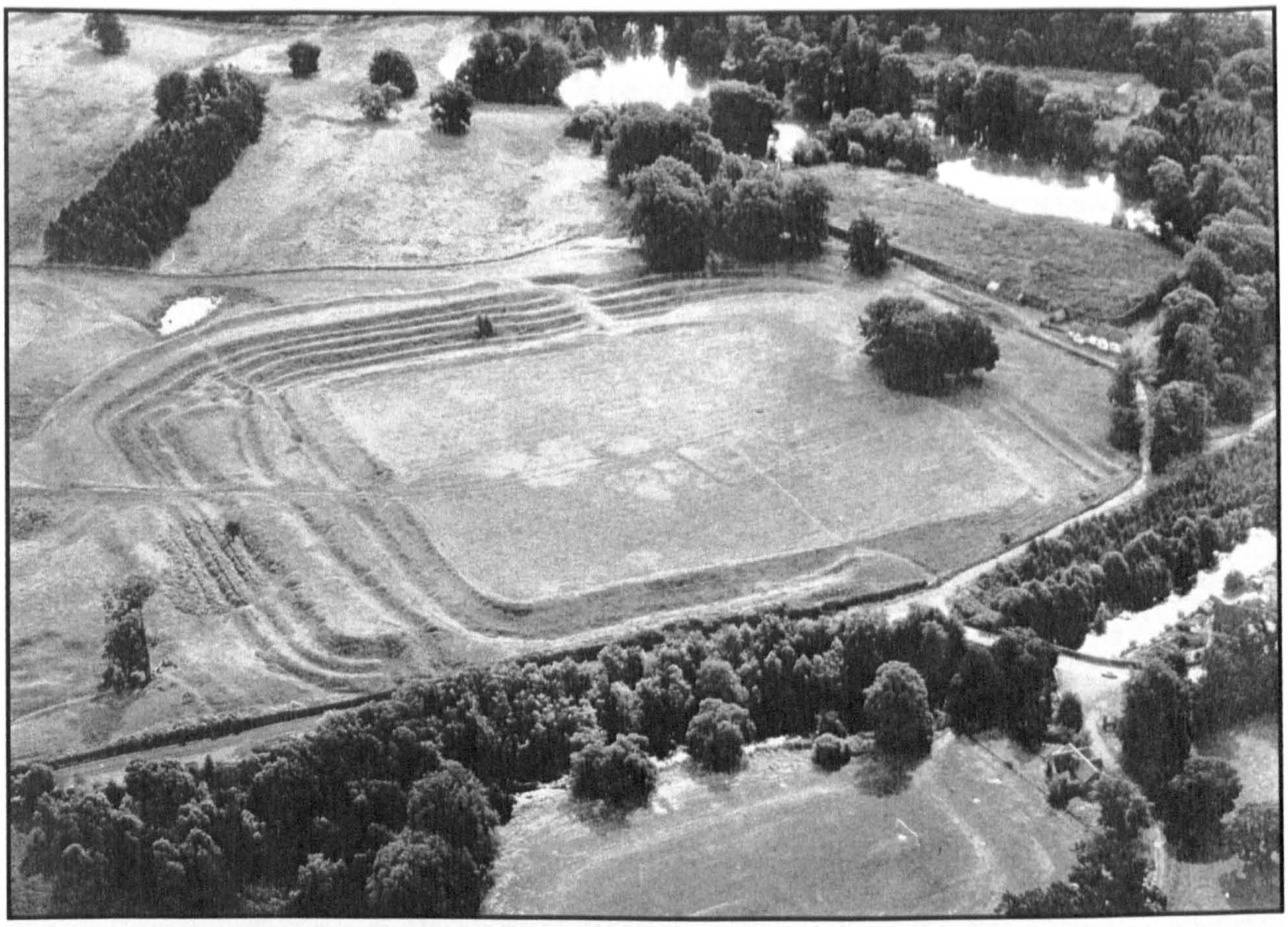

Figure 1.2. Ardoch Roman fort. PT 6383 (1979) © *Crown Copyright RCAHMS.*

A number of modern writers have discussed the effects that cultivation and land improvements have had on the survival and visibility of archaeological monuments (e.g. Stevenson 1975; Darvill 1987; RCAHMS 1990; 1994; Macinnes 1993; Darvill and Fulton 1998). Well-preserved monuments in some military training areas such as the Salisbury Plain Training Area (Barnes 1999; McOmish *et al.* 2002) and the Kirkcudbright Training Area (Cowley 2003) have been spared the rigours of modern agriculture since their purchase by the War Department. Other writers have highlighted the rarity of early agricultural remains in lowland areas of Scotland, suggesting that they might be best preserved beneath modern farm buildings (Foster and Hingley 1994) or archaeological monuments (Barclay 1989).

1.4.2.2 Livestock farming

The principal causes of visible livestock damage to archaeological monuments are trample and scarring (Streeten 1994). Poaching is often exacerbated by the concentration of livestock around gates or feeding troughs (as shown in figure 1.3), while rilling can be accelerated through increased water run-off caused by compaction of material by trampling and vegetation removal caused by poaching (ibid.). Although overgrazing by sheep can also cause scarring (figure 1.4) and erosion (Swanson 2001; Beamish 2001), light grazing by sheep is recognised as one of the best management regimes on archaeological monuments, as it prevents the colonisation of harmful scrub vegetation whilst maintaining low vegetation cover, without causing excessive poaching (Taylor 1994, Historic Scotland 1997).

Figure 1.3. Cattle poaching in Dumfries and Galloway exacerbated by wet weather and concentration of stock around a feeding trough. Photograph courtesy of Dr Noel Fojut.

The effects of poaching and erosion by stock on archaeological remains will vary depending on the nature of the remains in question. Darvill (1987, 88) has pointed out that archaeological features in pasture areas will often lie close to the ground surface, making them particularly susceptible to damage from poaching by stock. During an evaluation of a damaged burial mound at Maryton Law, Angus, Dalland and Carter (1998) noted that stock erosion was highest under trees where the animals had been sheltering from the weather. They also noted that although visible indications of damage from stock were high, there was little evidence of archaeological information loss, primarily due to the mound being composed of high volume, sterile sediments. Nevertheless, numerous studies (e.g. Berry 1994; Lee 1994; White 1994; Rimmington 2001; Beamish 2001) have highlighted the problems caused by stock erosion on monuments, frequently exacerbated by scrub growth or burrowing animal activity.

Figure 1.4. Earthwork scarring caused by sheep rubbing. Note also the rabbit burrow at the left of the scar. Hareheugh, Upper Coquetdale, Northumberland. Photograph courtesy of Dr Noel Fojut.

In pasture areas, damage can also occur to archaeological monuments through grassland improvement, either through subsoiling and drainage work (Darvill 1987, 87) or through ploughing and re-seeding, which, in some areas, will occur every five to eight years (SAC 2003, 35).

1.4.2.3 Other farming-related damage

Because farming operations remain outwith planning control, there are many farming-related processes that can damage archaeological monuments. Macinnes (1993) has highlighted the negative impacts of fencing, tracks, drains, stone removal and stone dumping (figure 1.5), while Swanson (2001) includes the removal of hedgerows and dykes. Darvill (1987, 21) has emphasised the damage caused by increased mechanisation in farming, while Wordsworth (1998b) and Dormor (1999) have pointed out that the siting of some farm buildings is not controlled by planning legislation, leaving archaeological remains at risk of inadvertent damage though the inappropriate location of new agricultural structures.

Figure 1.5. Stone dumping on a burial mound isolated in an arable field, altering the profile of the monument. Monument name and location withheld.

1.4.3 Forestry

The negative impacts of forestry operations on the archaeological resource are well-documented (Jackson 1987; Darvill 1986; Proudfoot 1989; Barclay 1992b; Macinnes 1993; Swanson 2001). Ground preparation, particularly the ploughing that was widespread in the 1960s, 70s and 80s (though seldom practiced now (Fojut 2002, 203; Crow 2001, 9)) can be particularly destructive towards archaeological remains, but other operations, such as fencing, building access tracks and felling all have the potential to damage archaeological remains (Darvill 1986; Mercer 1980; Macinnes 1993). Mercer (1980, 107) examined the effects of forestry ploughing at Long Knowe, Eskdalemuir, Dumfries, and found that although destruction of archaeological deposits was complete where the ploughshare has gone through, the furrows were spaced about 2m apart, and that between the furrows, useful information could be retrieved. He thus concluded that one episode of ploughing, although making site interpretation more difficult, would affect only a small proportion of the site. However, Mercer argued that a second episode of ploughing would treble the amount of damage and make the site uninterpretable (ibid.). Forestry can also have further, less visible impacts on the archaeological resource. For example, upland planting is often accompanied by the creation of drainage ditches (Crow 2001). Even if the planting does not encroach upon archaeological remains, changes in sites hydrology (particularly in upland bogs) can cause the loss of anaerobic conditions, accelerating the decay of artefactual and palaeoenvironmental evidence (ibid, 10).

Dunbar (1989) has summarised progress in forestry until the late 1980s. Following the creation of the Forestry Commission in 1919, 20 years of steady tree planting occurred until the Second World War, when further felling was necessary. Following the Second World War, there was a rapid expansion of Forestry Commission planting which continued to increase in rate until the late 1970s, while the 1980s saw a decline in Forestry Commission planting but a marked increase in private forestry (ibid.). The periods of large-scale planting of the 1960s, 70s and 80s saw considerable tension between archaeologists and foresters. Early recognition of the problem saw emergency forestry surveys between 1951 and 1958 conducted by RCAHMS, and the Ordnance Survey archaeology division also recorded a number of threatened monuments, some of which were subsequently left unplanted (Dunbar 1989, 13). However, many recorded monuments (and an unquantifiable number of unrecorded monuments) were ploughed and planted. Such was the level of concern among archaeologists about the effects of forestry that a symposium was organised in 1987 to bring to attention the impacts of forestry on the archaeological resource. This saw the publication in 1989 of *Our Vanishing Heritage* (Proudfoot 1989), which stands today as a reminder of the advances in cooperation made by foresters and archaeologists since the late 1980s.

That archaeology must be taken into consideration by foresters is now recognised. Since July 1988 it has been Forestry Commission policy that planting should not damage archaeological sites regarded as important by archaeologists (Shepherd 1992). In 1995, the Forestry Commission published *Forests and Archaeology Guidelines*, a set of guidelines aimed at protecting archaeological sites from damage caused by forestry operations. Fojut (2002, 203) has pointed out that although archaeologists still have concerns about new forestry planting, these concerns tend to centre on the management of monuments left unplanted in areas of new planting rather than the possibility that the monuments will be destroyed during the planting. All new forestry planting and felling that takes place with financial support from the Forestry

Authority is undertaken with regard for the archaeological resource, though there is still potential for damage to take place if planting takes place without grant aid from the Forestry Authority (Fletcher 1997). Furthermore, management of archaeological sites is now incorporated into Forest District Management Plans (Yarnell 1999). Under the Scottish Forestry Grants Scheme (the most recent grant scheme for private sector forestry), applicants must undertake a rudimentary environmental impact assessment by collecting information on natural and built environment concerns and including details of proposed mitigation in the application (Fojut 2002, 206). Unfortunately, as Barclay (1992b) has pointed out, monuments in areas of improved grassland, where extant remains have been levelled but cropmarks and parchmarks are seldom recorded, may still be damaged or destroyed simply because they cannot be identified without excavation. The recent *Forests for Scotland – The Scottish Forestry Strategy* (Scottish Executive 2000) has set a target of increasing woodland and forestry cover in Scotland from its current 17% to around 25% in the next 50 years, suggesting that significant planting programmes have yet to be embarked upon. Carter (2002, 212) has suggested that this emphasis on a high quality woodland resource will results in increased planting on better quality land such as improved pasture, where trial archaeological excavations will be required in advance of planting.

1.4.4 Natural threats and processes of damage

Although a number of natural processes and factors are known to be detrimental to the archaeological resource, MARS found that natural process accounted for only about 3% of wholesale loss, suggesting that the impact of natural processes in England has been relatively minor. However, MARS also found that 22% of piecemeal loss could be attributed to natural factors such as coastal and river erosion, visitor erosion and burrowing animals (Darvill and Fulton 1998, 137).

1.4.4.1 Erosional processes

Coastal erosion is probably the best researched form of natural erosion in the UK (Ashmore 1993; Darvill and Fulton 1998, 137; Dawson 2003). In 1993, over 300 monuments in the Northern and Western Isles of Scotland were believed to be under threat from coastal erosion (Ashmore 1993). Since then, systematic survey of a 20% sample of Scotland's coastline has suggested that there are as many as 12,000 monuments vulnerable to coastal erosion in Scotland (Breeze 2003, ix). Coastal erosion within the study area of this research is likely to have had a significant impact on the archaeological resource, with Lees (2003, 19) suggesting that about 30% of beaches in Tayside and Fife are currently eroding. The monitoring of the coastal resource continues in Scotland, increasingly though community involvement (Fraser *et al.* 2003).

Natural sub-aerial processes of erosion such as wind deflation, hillwash, soil creep, rilling and gully erosion can be accelerated through human activities such as farming and forestry operations (Schiffer 1987; Davidson and Grieve 2003). In the lowlands, soil erosion is most commonly demonstrated by gullies and rills, while in upland areas, erosion is generally evidenced by gullying, slope failures and peat hagging (Davidson and Grieve 2003). Although soil erosion can lead to the removal of archaeological deposits or features, it has also been found to have had beneficial effects on archaeological remains, such as at Upper Suisgill in Sutherland (Barclay 1985), where a series of hillwash episodes had covered early settlement evidence, sealing it from damage during later occupation of the same site. In addition to the acceleration of erosion caused by some farming and forestry activities, erosion by visitors is also a considerable concern at many monuments (Darvill and Fulton 1998, 138), precipitating the need for remedial works at some (e.g. Rees 1994; Frodsham 1994; Wimble 1994; Stockdale 2001; Wills 2001).

1.4.4.2 Bioturbation

Archaeological sites are, by their very nature, susceptible to damage by burrowing animals. Understanding of the effects of burrowing animals on archaeological sites is varied, depending on the species in question. Schiffer (1987) has identified two different groups of animals that cause the turbation of archaeological deposits: Sub-surface foragers, such as earthworms, and surface foragers, such as rabbits and badgers. Each group is thought to have distinct effects on archaeological deposits. Earthworms, the most widespread type of sub-surface foragers, are thought to be responsible for the movement of artefacts and bone both horizontally and vertically through the soil (Armour-Chelu & Andrews 1994). In the case of surface foragers, the effects of burrowing are different. According to Schiffer (1987), instead of completely churning deposits as earthworms do, they leave behind filled-in burrows known as *krotovina* (ibid.), where the tunnels are filled in with material introduced by other agents such as wind and water.

Work in Scotland (Dunwell & Trout 1998) has identified three principal negative effects of burrowing into archaeological earthworks. Firstly, disfigurement, when the clarity of the field characteristics of the site are reduced; secondly, destabilisation, when the monument is left open to further degradation by other agencies; finally, irretrievable information loss, when buried remains are so disturbed that valuable archaeological information is destroyed. Barclay (1994) identified rabbits as the largest single threat to earthwork conservation in Eastern Scotland in 1994, and recent studies within the study area (e.g. Strachan 1997; Glendinning and Dunwell 2000) have emphasised the threat and degree of information loss caused by rabbits.

1.4.4.3 Floralturbation

Although tree root systems are believed to disturb archaeological features, the precise impacts of trees on archaeological deposits remain poorly understood (Crow 2001; Fojut 2002). Schiffer (1987) has argued that tree roots will move artefacts, divorcing them from their original archaeological contexts, while windthrow is also considered a particular threat, not only because of the initial disturbance caused by the wrenching of the tree rootplate from the ground (Barclay 1992b, Crow 2001), but also due to the subsequent creation of erosion scars (Streeten 1994). Tree roots are believed to follow the path of least mechanical resistance (Dobson and Moffat 1993), and as archaeological deposits are frequently softer than their surroundings, it is likely that in some cases, tree roots follow archaeological deposits as they grow. Crow (2001) has pointed out that tree roots are also likely to damage waterlogged archaeological deposits through increased moisture uptake (reducing soil moisture content). Trees are also thought to be responsible in some cases for the destabilisation of earthworks, though Crow (2001) has argued that trees can aid earthwork stability and help prevent the colonisation of damaging scrub vegetation, arguing that much of the evidence of tree damage on archaeological sites is anecdotal and not based on factual data. Furthermore, tree root systems vary greatly in terms of their structure and level of mechanical root penetration (ibid. 2001,18).

A number of recent studies demonstrate some of the effects of tree growth on monuments. Collier *et al.* (2003) found during geophysical survey at Capo long barrow, Aberdeenshire, that tree roots and rabbits had clearly had little effect on the major structural elements of the monument, such as the revetments and façade. However, on the basis of this geophysical survey, it was not possible to assess more subtle damage such as mixing of stratigraphy. By contrast, upon the excavation of a kerbed cairn at

Coupar Angus in Perthshire, Stevenson (1995) found that in addition to damage caused by human activity, there was significant disturbance of the archaeological levels by tree roots and burrowing animals. Because disturbance was so pronounced, stratigraphic relationships between many contexts could not be identified. Meanwhile, Barclay and Maxwell (1991) found that some stratigraphic relationships could not be observed at an excavated Neolithic long mortuary enclosure at Inchtuthil, Perthshire, due to disturbance caused by tree roots. Survey and limited excavation by Kirkdale Archaeology at Kennel Mount Cairn in Culzean Country Park, Ayrshire (Kirkdale Archaeology 1999) included an assessment of the damage caused by tree root growth and windthrow. It was estimated that windthrow had damaged at least 10% of the surface are of the cairn. The excavations were limited in extent, however, and so the quantification of disturbance to archaeological deposits lower down in the cairn was not possible. While vegetation cover on archaeological sites is sometimes advantageous in helping counteract erosion by wind and water, some types of vegetation, such as bracken, have substantial rhizome systems that can cause extensive damage to archaeological deposits (Rees and Mills 1999). Bracken may also attract colonisation by rabbit populations (ibid.).

Darvill and Fulton (1998, 139), Crow (2001) and Fojut (2002) have all argued that precise understanding of natural processes of damage at archaeological monuments is poor. Moreover, many of the processes that have traditionally been seen as detrimental to the archaeological resource are increasingly being viewed as less damaging than previously thought. Fasham (1980) and Macinnes (1993) have both highlighted the role of woodland cover in preventing monument destruction that agricultural land uses might cause, and Fojut (2002, 204) has suggested that in some cases, the retention of tree cover at monuments may be preferable to the clearance of trees. Rimmington (2001) has also argued for the retention of mature scrub on earthworks under certain circumstances. In their recent survey of Strathdon, RCAHMS deliberately examined shelter belts in lowland areas, recording cultivation remains, burial cairns and hut circles that would not have survived under agricultural land uses (Halliday, pers. comm.).

1.4.5 Other factors in monument loss

It is worth considering briefly other variables that might influence the loss of archaeological monuments. As demonstrated by MARS, a monument's construction material and visibility will have a bearing on its long-term survival (Darvill and Fulton 1998). Furthermore, the identification of monuments and the accessibility of information relating to their position and spatial extent will affect their likelihood of survival in the event of development or land use change (Breeze 1989, Yarnell 2003). Finally, the role of the individual landowner in determining a monument's condition and preservation should not be underestimated, a point emphasised by Darvill (1987,1) and Wordsworth (2003, 23). While land use, legislation and natural processes all contribute to the condition of a monument, in nearly every case, responsibility for the condition of a monument with its owner or manager. Miles (1980, 81) and Holbeche (1980, 135) have argued that most destruction of monuments in agricultural land during the 1970s occurred either through ignorance of the remains, or because of economic pressures. Research by Westmacott and Worthington (1997) has illustrated the range in attitudes of farmers in the south of England towards landscape management, while Holbeche (1986) has pointed out that farmers are individuals and should be treated as so. As individuals with individual attitudes to and knowledge of the archaeological resource, landowners and land managers thus constitute as great an influence on the condition of a monument as the land use within which it is situated.

1.5 Past research into quantifying loss of the archaeological resource

Although loss of the archaeological resource through various processes, both natural and anthropogenic, has long been recognised, until recently, little systematic research to quantify this loss has been attempted. The two large-scale projects described in section 1.1 (Darvill and Fulton 1998; Oxford Archaeology 2002) currently stand alone as the only national scale (England) projects to examine or quantify changes in the extent and condition of the archaeological resource in the UK. However, a number of smaller recent and ongoing projects have included a systematic analysis of monument loss. *The Past under the Plough* (Hinchcliffe and Schadla-Hall 1980) contains a number of papers seeking to quantify loss of monuments through arable farming (e.g. Drewett 1980; Gingell and Schadla-Hall 1980), while Oxford Archaeology's *Management of Archaeological Sites in the Arable Landscape* (Oxford Archaeology 2002) also contains a number of regional studies into the effects of modern agriculture on the archaeological resource. Two further regional studies (Finlayson *et al.* 1999; Bowes 2003) are discussed in chapter 6, and King Alfred's College Winchester have undertaken a project since 1999 examining a number of the effects of agriculture on the archaeological resource in the Quantock Hills of Somerset (Wilkinson and Thorpe 1999). Finally, the ongoing Upper Clyde Valley Landscape Project, based at Glasgow University, includes among its aims the identification of land-use changes in relation to site survival (Hanson and Sharpe 1999; Sharpe 1999). Interim reports have identified forestry and arable cultivation as the main threats to archaeological sites within the Upper Clyde Valley.

1.6 General research aims and framework

1.6.1 General research aims

Given the many threats to the archaeological resource outlined, there is scope for further research into virtually any aspect of archaeological resource management. The precise effects of farming, forestry and natural processes such as tree growth and bioturbation remain relatively poorly understood. There is also scope for an assessment of the impacts of various legislative measures such as the AMAA Act 1979, NPPG 5 and NPPG 18. As mentioned in section 1.1, however, although MARS has quantify monument loss attributable to many of the processes outlined in England, no equivalent systematic research has been undertaken in Scotland. Given the marked regional variations in monument survival identified by MARS (Darvill and Fulton 1998, 114-117, 124), it must be assumed that extrapolation from MARS and other English-based projects to estimate loss rates in Scotland would be crude at best. Consequently, this study is designed to fulfil a similar function to MARS for Eastern Central Scotland. It is primarily a broad brush survey, providing statistics on current monument distribution patterns and the rates and mechanism of monument loss. In general terms, therefore, the aims of this research are analogous to those of MARS, but its scope and complexity are, by comparison, limited.

Rather than attempting to increase technical understanding in specific areas of archaeological resource management, this research draws on existing knowledge and theory about archaeological resource management and damage processes at sites, and seeks to quantify and explain monument loss at a regional scale using existing knowledge and perceptions. A number of factors, including time constraints, limited manpower and the limitations of existing archaeological data have combined to ensure that this research is general by definition, and this is reflected in the over-arching aims of the research. Due to this generality of the research, the research is not hypothesis driven. Rather, it seeks to:

1. Provide a sample-based census characterising the nature and distribution of recorded archaeological monuments in eastern central Scotland.
2. Quantify and analyse monument condition change in eastern central Scotland since 1850.

3. Identify and evaluate the processes responsible for observed changes in monument condition.
4. Assess the implications of the results in ongoing and future archaeological resource management.

These aims provide the basis for more detailed research objectives which pertain to specific issues, as outlined in chapters 2 and 6.

1.6.2 Research framework

The research framework has evolved around the research objectives outlined above. In order to achieve the research objectives, it has been necessary to collect a wide range of data such as land use, monument condition and legal status for a large number of monuments. This has been achieved through a large desk-based study, making use of existing records, GIS datasets and maps. The results produced by the desk-based study have been affected by limitations in the data sets used, however, and so it has been necessary to undertake an accuracy assessment, which, although primarily desk-based, has also involved a programme of non-invasive field survey. While the data collected through the accuracy assessment have enabled calibration of many of the figures produced through the desk-based study, the programme of field survey undertaken has also allowed the identification and analysis of ongoing and recent management issues at a sub-sample of the monuments examined through the desk-based study.

The desk-based study, accuracy assessment and field survey have enabled most of the research objectives to be achieved where the monuments examined are extant and visible. These approaches have retrieved little meaningful data relating to condition changes and management issues relating to cropmark monuments, however. Consequently, it has been necessary to employ an alternative approach to include cropmark archaeology in the research, based on limited excavations and basic modelling techniques using GIS.

Chapter 2

2. Data sources and methodologies

In order to address the four key research objectives outlined in section 1.6, it has been necessary to collect a wide range of information for a large number of monuments through a large desk-based study. The main benefit of undertaking the research in this manner is that it has allowed the rapid interrogation of existing data sources such as photographs, excavation reports and existing surveys. Data collection has also been aided by the use of Arcview GIS, computer-based Geographical Information Systems software which has enabled the swift extraction of spatially derived attributes such as elevation, land use and local authority area. In most archaeological projects, some form of desk-based assessment is undertaken, usually to provide background and historical information before any planned survey or excavation. Although such desk-based work is usually limited in scale, its value has been demonstrated in projects such as MARS (Darvill and Fulton 1998) the *Management of Archaeological Sites in the Arable Landscape* project (Oxford Archaeology 2002), and the Upper Clyde Valley Project (Sharpe, pers. comm.).

The use of existing data sets is not without its pitfalls. Although making use of desk-based assessments, MARS and the Upper Clyde Valley Project have also demonstrated that the assessment of monument condition is most accurate and most easily achieved through fieldwork. In any desk-based study, there is little control over the data sets available for interrogation. This is particularly true of older archaeological documentary sources, in which author subjectivity is inevitably a factor. Nevertheless, in order to obtain a wide range of information (much of it spatially derived and available in digital form) on a large number of monuments, it has been necessary to base this research upon a desk-based study. The results of this desk-based study have then been calibrated, using the results of an accuracy assessment undertaken for a sub-sample of monuments.

2.1 Data sources available for interrogation

The data collected through the desk-based study fall into two groups. First, data on the archaeological characteristics and condition of each of the individual sample monuments, such as period, construction type and condition. The second group of data pertains to the physical environment and legal circumstances of each sample monument, such as land use, elevation and local authority area. A review of the data sources available at the outset of the research showed that there was considerable scope for the collection and analysis of data pertaining to these and other variables. Some of the sources reviewed are outlined here.

2.1.1 Sources of data relating to monument characteristics and condition

2.1.1.1 Inventories

A number of sources hold information on the archaeological characteristics and condition of monuments within the study area. First, there are Monuments inventories published by the Royal Commission on the Ancient and Historical Monuments of Scotland. However, their geographical coverage is not complete, and many are outdated. For example, the inventory for Angus was published in 1911, while the Fife inventory was published in 1933. Their contents reflect the focus of archaeological study at their dates of print, with a heavy emphasis on prehistoric funerary, ceremonial and defensive monuments. Not surprisingly, neither contains any information on cropmark monuments. By contrast, the two most recently published inventories describing the archaeological landscapes of North-East Perth and South-East Perth contain plentiful information on medieval or later rural settlements (MoLRS), which are largely ignored by the early inventories (RCAHMS 1990; 1994). Furthermore, the South-East Perth volume contains a comprehensive review of the rich cropmark record of this area (RCAHMS 1994), which breaks away from the list-type structure of its predecessor to provide archaeological synthesis. Although accurate and relatively up to date information on the archaeological remains within the study area are held in these two publications, given these inconsistencies in the coverage provided by some of the inventories, it has been necessary to seek additional and alternative sources of information.

2.1.1.2 Statistical Accounts

The New and 3rd Statistical Accounts, compiled by parish ministers at various dates in the 19th century, provide written accounts of changes in parish life such as population change and trends in employment. They also make occasional reference to archaeological monuments, and provide the first written account of many of the monuments within the study area. The Statistical Accounts have been used in other projects, to identify variations in sea level in Scotland (Leask 1996), and, in ongoing research at Stirling University, to locate deepened plaggen soils (Thomas, pers. comm.).

2.1.1.3 Emergency and Marginal Land Surveys

In 1942-43, during the Second World War, a number of Emergency Surveys were conducted at monuments thought to be at risk of destruction owing to their location in military training areas. About 110 monuments were surveyed in Tayside and Angus, when their visible extent and appearance were noted, though specific reference to site condition was seldom made. The surveys remain unpublished. In the following decade, between 1951 and 1958, RCAHMS conducted a number of surveys of monuments in marginal land under threat from expanding agriculture in the post-Second World War drive for self-sufficiency. RCAHMS still holds the survey manuscripts for approximately 110 sites in Tayside and Angus, with a further 42 sites in Fife. Like the Second World War emergency surveys, these remain unpublished.

2.1.1.4 Sites and Monuments Records

With the exception of Dundee, each of the local authorities within the study area maintains a Sites and Monuments Record (SMR). However, in the autumn of 1999 when this research was commenced, Perth and Kinross did not have a Regional Archaeologist, let alone an SMR, and so the use of SMRs was discounted at an early stage. In early 2002, contact with the Regional Archaeologists for Perth and Kinross and Stirling showed that the data contained on the SMRs for each of these local authority areas on each of the sample monuments seldom extended beyond the information held in the NMRS (Strachan; Main, pers. comm.). It was found that the SMR for Angus did contain additional information on three of the sample monuments. For the most part, however, information in the Angus SMR did not extend beyond the information held in the NMRS (Greig, pers. comm.). No SMR data could be obtained for Fife, but the information obtained from the three other SMRs investigated showed that the results of the research were unlikely to have been adversely affected by the omission of SMR data.

2.1.1.5 The National Monuments Record of Scotland

All of the sources described provide fragmentary geographic or temporal coverage of monuments within the study area. In order to maintain consistency in the data used in the desk-based study, none has be used as a primary data source on monument characteristics or condition. The only data source with coverage across the entire study area at the start of this research was the National Monuments Record of Scotland (NMRS). It contains much of the data from the statistical accounts and monuments inventories, as well as information from the Ordnance Survey surveys and more recent archaeological survey conducted by RCAHMS. Information from archaeological excavations is often included in the NMRS also. Even within this database, however, there are considerable inconsistencies in the quality of information held for different types of monument. The monument group which generally lacks detailed information in the NMRS is that of cropmark monuments. Most have only been discovered in the last 30 years, and the majority have no written description in the NMRS. Other monuments for which there is generally a lack of information in the NMRS are MoLRS. By contrast, many of the 'status' monuments such as tower-houses and Roman sites have a great deal of information recorded in the NMRS. These inconsistencies notwithstanding, the NMRS remains the most comprehensive and easily accessible source of information on monuments within the study area. For this reason, the NMRS has been used as the primary source of information on the archaeological monuments examined in this research.

2.1.1.6 Historic Scotland Monument Warden survey data

Although the information provided by the NMRS has been used as the primary data source on the characteristics and condition of the monuments examined in this research, it has been necessary to interrogate additional data sources in order to obtain more detailed information on some of the monuments examined. Monument Wardens are employed by Historic Scotland to visit scheduled monuments and record their condition every three to five years. Some data from these condition reports was supplied by Historic Scotland in June 2000, and has been used in this research. As the warden information exists only for scheduled monuments, its use in this research has been selective.

2.1.1.7 Vertical aerial photographs

Further information on changes in monument condition can be observed from the large collection of vertical and oblique aerial photographs maintained by RCAHMS, which again, have been used selectively (but with some success) in the current research. The vertical aerial photographs for the study area date to three broad phases: Firstly, the whole of Scotland was photographed by the RAF in the years immediately following the Second World War at a base scale of 1:10,000. Secondly, the Ordnance Survey undertook a programme of aerial photography in the late 1960s and early 1970s. Most recently, the whole of Scotland was photographed in 1988-9 at a scale of 1:24,000 for the purposes of interpretation to create the Macaulay Land Use Research Institute's Land Cover of Scotland 1988 (LCS88). Figure 2.1 shows one of the sample monuments (a barrow) in pasture in 1946 and its position in 1988, where it has been ploughed and planted with conifers and partially destroyed by road construction.

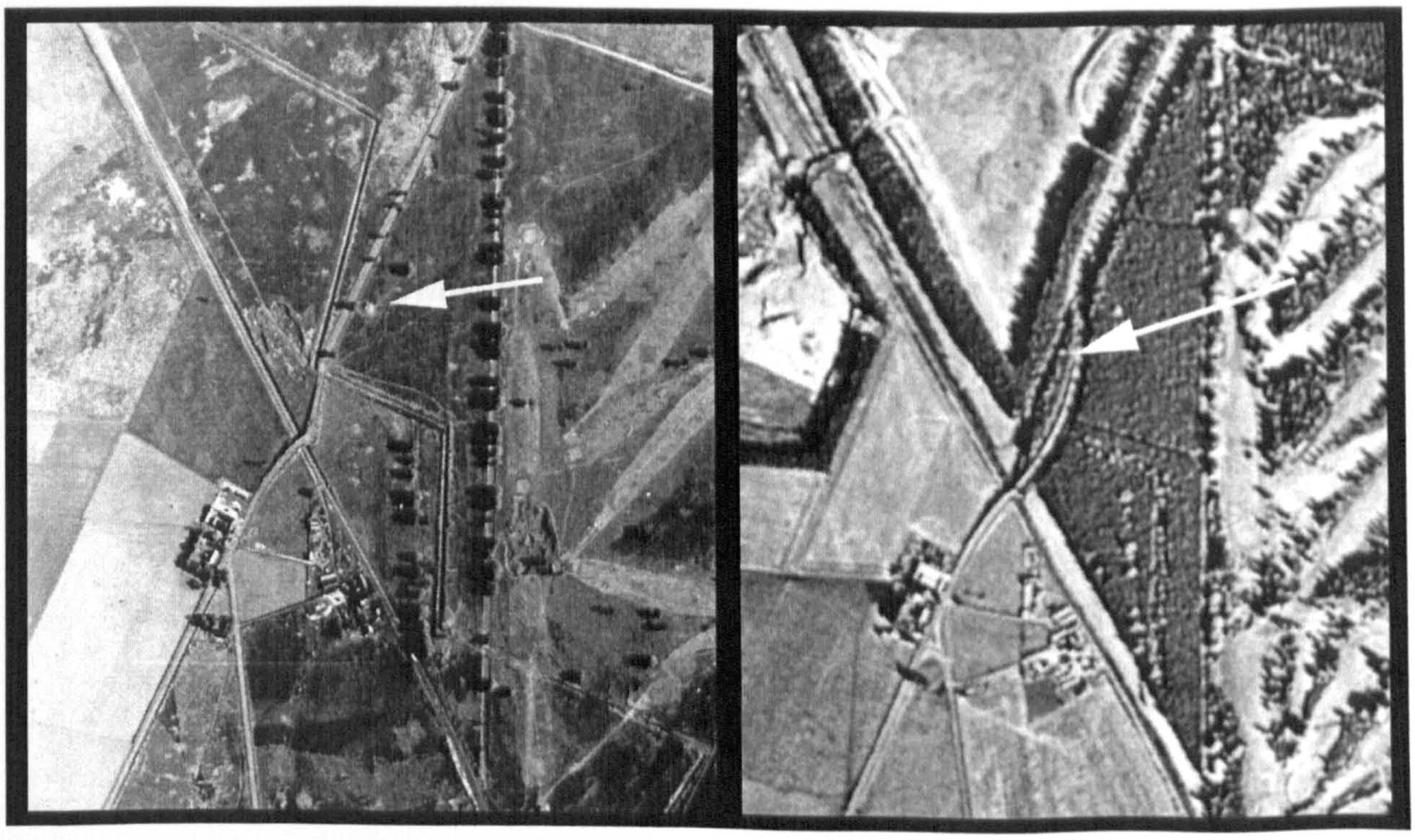

Figure 2.1. Barrow at Annsmuir, Fife (NMRS no. NO31SW 10) in 1946 (left picture-106G/Scot/UK120 3425) and 1988 (right picture-C253(88) 3488172). © *Crown Copyright RCAHMS.*

2.1.1.8 Oblique aerial photographs

The oblique aerial photographs maintained by RCAHMS are primarily of recent date. Some of the oblique photographs from the Cambridge University Collection of Aerial Photographs (CUCAP) date to the 1940s, but the majority date to the 1970s or later. Most are of cropmark monuments, though some are of visible archaeological features in upland settings. In some cases, it has proved possible to trace condition change through evidence of the destruction of part or the whole of a cropmark monument, but for the majority of cropmark sites, there may only be two or three seasons' photographs, restricting their use for purposes of reconstructing monument condition changes through time.

2.1.1.9 The First Edition Survey Project

Between 1995 and 2001, RCAHMS undertook a project mapping settlements depicted as unroofed on the First Edition Ordnance Survey 1:10560 map sheets (RCAMHS / Historic Scotland 2002, 5). This project, entitled the First Edition Survey Project (FESP) has added over 22,000 new records to the NMRS (ibid.; Macinnes 2003, 3). Within the NMRS, FESP records usually contain reference to the depictions on current OS 1:10,000 mapping also, providing direct comparison between the mapped extents of many MoLRS sites between the 1st Edition mapping of the 1860s and current mapping. An example of this is shown below, in the FESP description given in the NMRS for the possible township of Girron, near Amulree in Perthshire (NMRS no. NN93NW 4).

> What may be a township, comprising five roofed, three unroofed buildings and four enclosures is depicted on the 1st edition of the Ordnance Survey 6-inch map (Perthshire 1867, sheet lxxi). Two roofed buildings, one partially roofed building and three unroofed buildings are shown on the current edition of the OS 1:10000 map (1982).
> Information from RCAHMS (AKK) 4 February 1998.

As further illustration, figure 2.2 (overleaf) shows extracts for the two map sheets described in the FESP entry for Girron. However, because the majority of FESP monuments had not been visited and verified in the field at the time this research commenced, the application of data derived from the FESP in this research has been limited.

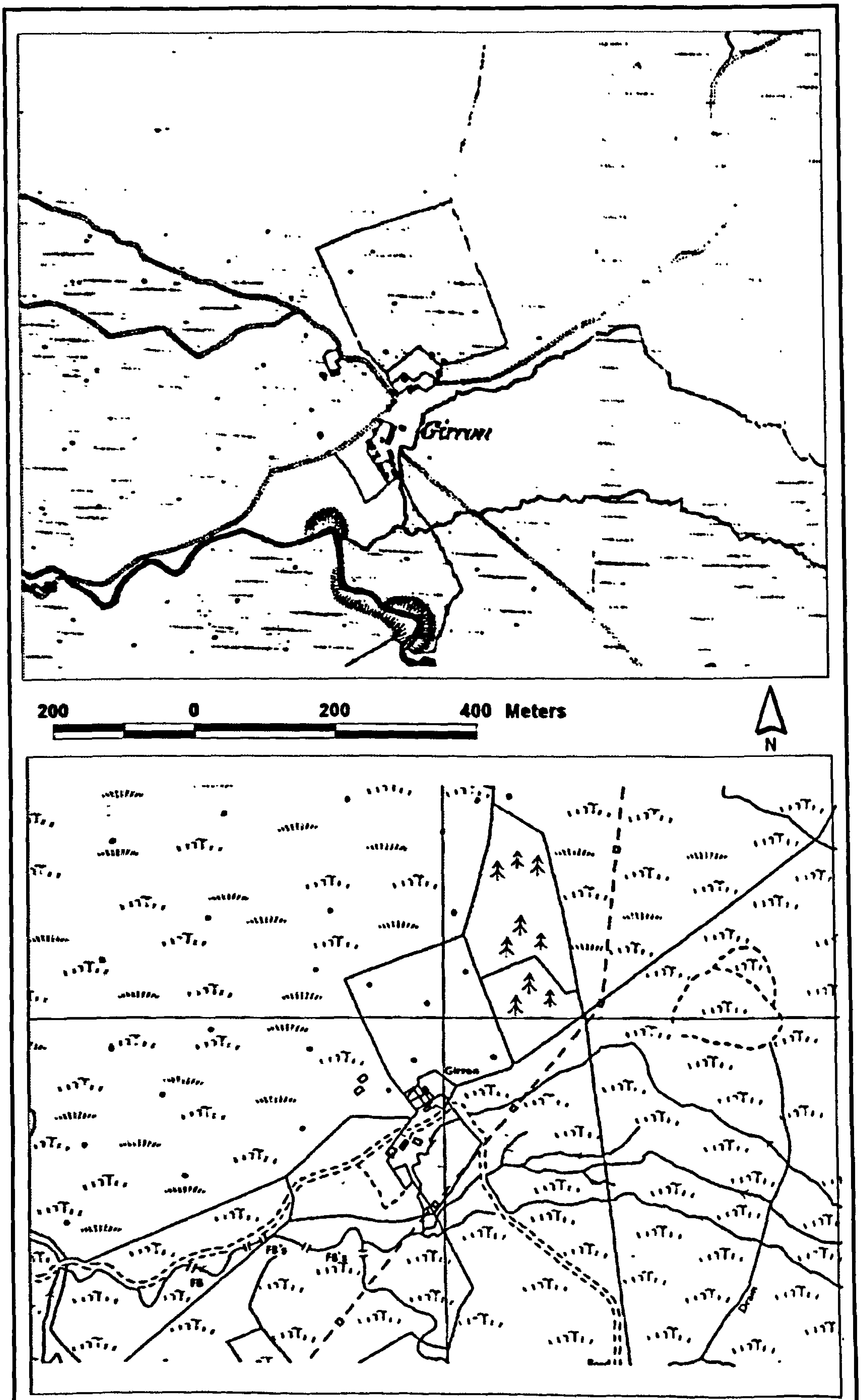

Figure 2.2. Map extracts of 1867 (upper map) and 1982 (lower map) showing the possible township of Girron, Perthshire. ***1st Edition map © Crown copyright and Landmark Information Group Ltd. Current map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004].***

2.1.1.10 Field survey

The final method used in this research to record monument condition has been a programme of field survey. This has been undertaken for about 8% of the monuments examined through the desk-based study, and has proved very successful in providing data not available from other sources. Furthermore, it has enabled the formation of some detailed monument condition histories, based on discussions with landowners and farmers.

2.1.2 Sources of data relating to the physical environment

2.1.2.1 Present land use

Several sources provide data that relate to environmental and legal circumstances at each of the monuments of study. At a very monument-specific level, some entries in the NMRS describe recent land use on and around monuments. For the majority of monuments examined, however, it has been necessary to look to other sources to determine land use. Brooker (1998) summarises the five major sources of recent land cover information for the Scottish countryside:

1. The National Countryside Monitoring Scheme (NCMS), a study of changes in Scotland's land cover from the 1940s to the 1980s. It was instigated in 1983 by the Nature Conservancy Council (now defunct) and extended by Scottish Natural Heritage (SNH) (Mackey *et al.* 1998).
2. Land Cover of Scotland 1988 (LCS88), a nation-wide census of land cover based on aerial photographs taken in 1988 and 1989. LCS88 was undertaken by Macauley Land Use Research Institute (MLURI) (MLURI 1993).
3. The Countryside Survey 1990 (CS90), a detailed sample survey of vegetation communities and other countryside features. It was undertaken by the Institute of Terrestrial Ecology (ITE).
4. The Land Cover of Great Britain, a census based on satellite imagery, also undertaken by the Institute of Terrestrial Ecology (ITE).
5. The Agricultural and Horticultural Census, an annual parish level agricultural stock survey, maintained by the Scottish Executive Environment and Rural Affairs Department (SEERAD 1936-99).

At an early stage of the research, LCS88 digital mapping for the study area was made available. LCS88 is a national census on land cover in 1988, and was produced through the interpretation of aerial photographs, followed by field validation and the analysis of digitised data. The land cover classes, numbering 127 in total, are split into 6 broad groups (semi-natural ground vegetation, woodland, agricultural land, farms and developed rural land, bare ground, and miscellaneous features such as beaches, built-up land and snow cover (MLURI 1993). Although LCS88 was used at first in this research to determine land cover at each of the monuments of study, it was found that the mapping resolution was not fine enough to provide accurate land use information for many monuments (section 3.5.1). Therefore, current land use for each monument was determined through the examination of a combination of LCS88, current Ordnance Survey 1:10,000 mapping, and written accounts of land use in the NMRS. A further source of information on land use has become available since this research commenced in 1999. Land Cover Map 2000 is a vector database available in a number of formats, derived from a computer classification of satellite scenes obtained mainly from Landsat satellites (information from Centre for Ecology and Hydrology website (www.ceh.ac.uk)). It has not been used in the current research, nor has its potential application assessed.

A further source of land cover data, Historic Landuse Assessment (HLA) is available for parts of Scotland, but at the commencement of this research in 1999, coverage did not extend to any part of the study area. HLA is a mechanism developed jointly by RCAHMS and Historic Scotland to map the character of the landscape, identifying both the origins of its component parts and elements of earlier, relict landscapes surviving within it. Although HLA is a tool rather than a product (Dyson Bruce *et al.* 1999), its outputs include a series of maps which provide an overview of the historic landscape (RCAHMS / Historic Scotland 2000, 4). Although HLA has not been used in the current research, its potential in research of this type is assessed briefly in chapter 7.

2.1.2.2 <u>Past land use</u>

At the outset of the research, it was planned to collect detailed information on land use change since 1850 at each of the monuments examined. Although land use at each sample monument was recorded for a number of dates, ultimately, this data was to prove too complex to analyse effectively for the entire sample of monuments. However, the information did prove invaluable in developing condition histories at a number of specific monuments where further detail was required. The sources considered for use are outlined below.

In determining land use at the monuments of study before 1940, the most accessible sources available are the Ordnance Survey 1st and 2nd Edition 1:10,560 maps, produced in the late 1860s and early 1900s respectively. These provide a remarkable degree of information on land cover. Further maps at the same scale produced in the 1920s, 1930s, and 1940s also provide indications of land cover at these dates, but the maps available do not cover the entire study area.

The 1st Land Utilisation Surveys (Stamp 1944) provide specific land cover data for parts of the study area. These were undertaken in the 1930s, and were restricted to areas of arable farmland. Although a preliminary assessment of their potential use in this research was undertaken, it became clear that the map coverage held at the National Map Library of Scotland was too fragmentary to be of any great value. Furthermore, it is understood that many of the originals (held in London) were destroyed during economic riots in the 1970s (T Burke, pers. comm.).

Three sources have been used in the current research that describe changes in land utilisation.

1. The National Countryside Monitoring Scheme provides quantitative data on the distribution and extent of 31 areal and five linear feature types for the late 1940s, the early 1970s and the late 1980s (Mackey *et al.* 1994; 1998). It is based on the interpretation of air photographs of sample squares, and figures are available for Scotland as a whole, or for any of 12 regions.
2. The Agricultural and Horticultural Census provides statistics on agriculture in Scotland since 1866. Now maintained by the Scottish Executive Environment and Rural Affairs Department (SEERAD), the census data is collected through compulsory farmer questionnaires. Information by Parish, Local Authority or Region can be obtained for 1970 onwards, though this is subject to disclosure restraints (SEERAD 1999).
3. Published in 2001, the National Inventory of Woodland and Trees provides information on changes in the planting of woodland in Scotland since the 1860s and area of woodland in Scotland since 1885 (Forestry Commission 2001). It is based upon a number of data sources, including the LCS88 for partially determining current woodland cover, and for historical woodland cover data,

Ministry of Agriculture surveys and Forestry Commission national woodland inventories (ibid, 47).

Although the NCMS, Agricultural and Horticultural Census and the National Inventory of Woodland and Trees provide detailed information on land use change at fixed points in time and trends in land use change, they do not provide site-specific land use information. Consequently, their application in this research has been restricted to identifying general trends in land use change.

As described in section 2.1.1, vertical aerial photographs for the study area exist for the late 1940s, the late 1960s / early 1970s, and 1988-9. These provide site-specific land use information at specific dates. They have not been examined for each of the monuments of study, but have been used extensively for the sub sample of monuments examined through the accuracy assessment.

2.1.2.3 Land Capability Classification for Agriculture

MLURI's Land Classification for Agriculture ranks land according to the extent to which its physical characteristics (soil, climate and relief) impose long term restrictions on its agricultural use (MLURI 1991, 1). There are seven general classes of land capability for agriculture, summarised in table 2.1.

LCA Class	Description
Class 1	Land capable of producing a very wide range of crops
Class 2	Land capable of producing a wide range of crops
Class 3	Land capable of producing a moderate range of crops
Class 4	Land capable of producing a narrow range of crops
Class 5	Land capable of use as improved grassland
Class 6	Land capable of use only as rough grazing
Class 7	Land of very limited agricultural value

Table 2.1. Basic description of LCA classifications.

Classes 3, 4, 5 and 6 are further sub-divided. Classes 3 and 4 each have two divisions based on increasing restrictions (such as climate and soil workability) to arable cropping. Class 5 has three sub-divisions, based on potential for successful reclamation, while class 6 has three sub-divisions, based on the value of the existing vegetation for grazing purposes (ibid.). Although LCA classification is not a physical characteristic in itself, it helps to summarise the character of land within defined spatial units and the likely land uses within these units. Consequently, LCA classification has been recorded for each of the monuments examined using the mapping of LCA classification (paper form only), which is available at the 1:250,000 scale.

2.2 The study area

2.2.1 Administrative areas

The study area measures 80km E-W and 60km N-S (corners at NN7000 0000, NO5000 0000, NN7000 6000 and NO5000 6000), encompassing much of the modern administrative council areas of Perth and Kinross, Fife, Angus and Dundee City (figure 2.3). It also includes small parts of Clackmannanshire and Stirling council areas. The total land area is about 4688 square km.

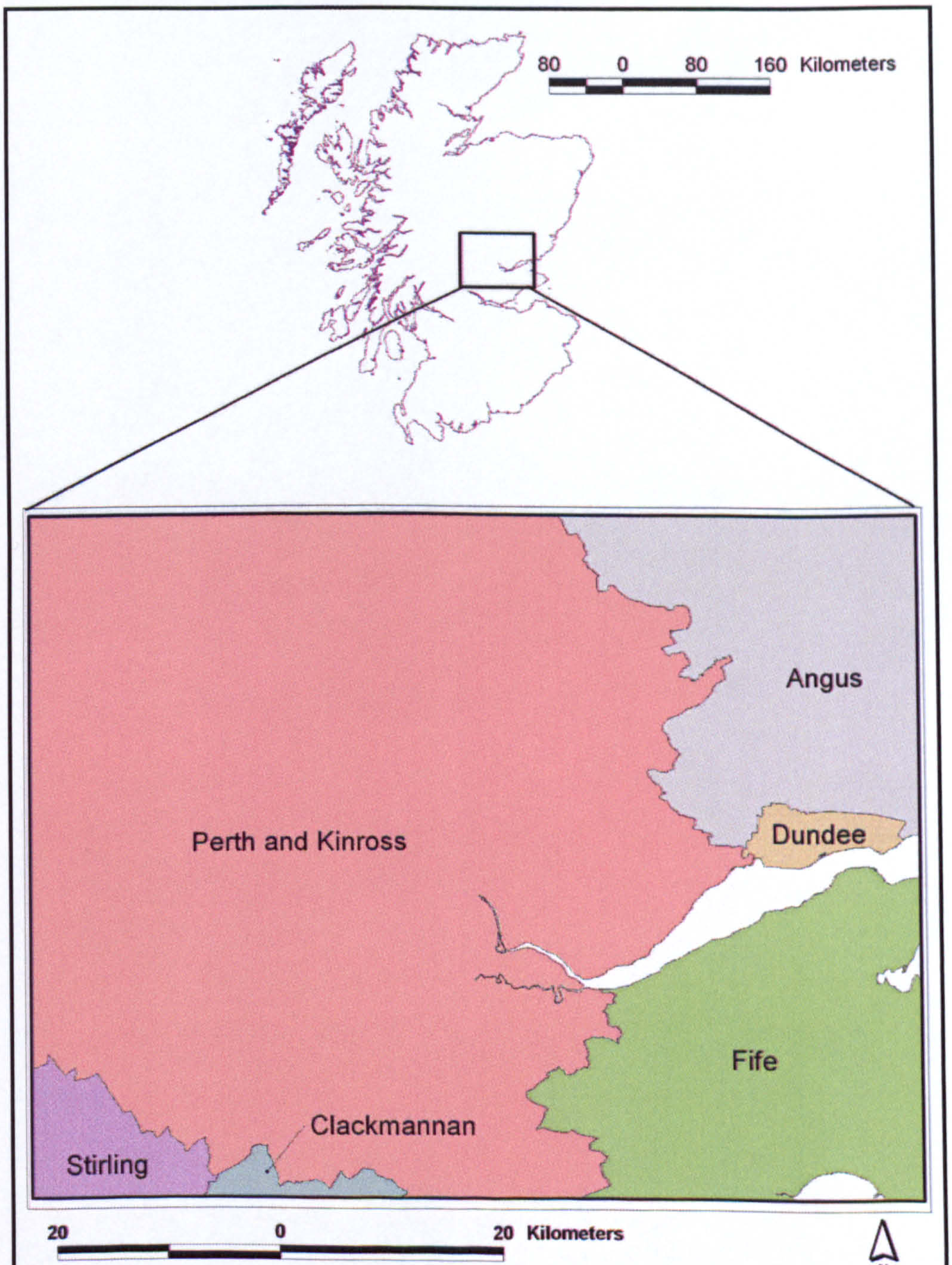

Figure 2.3. Study area location map showing local authority areas.

2.2.2 Topography, soils and drift geology

The topography of the study area is varied, primarily low-lying and gently undulating in the E and SE, while the W and NW are more precipitous, as shown in figure 2.4.

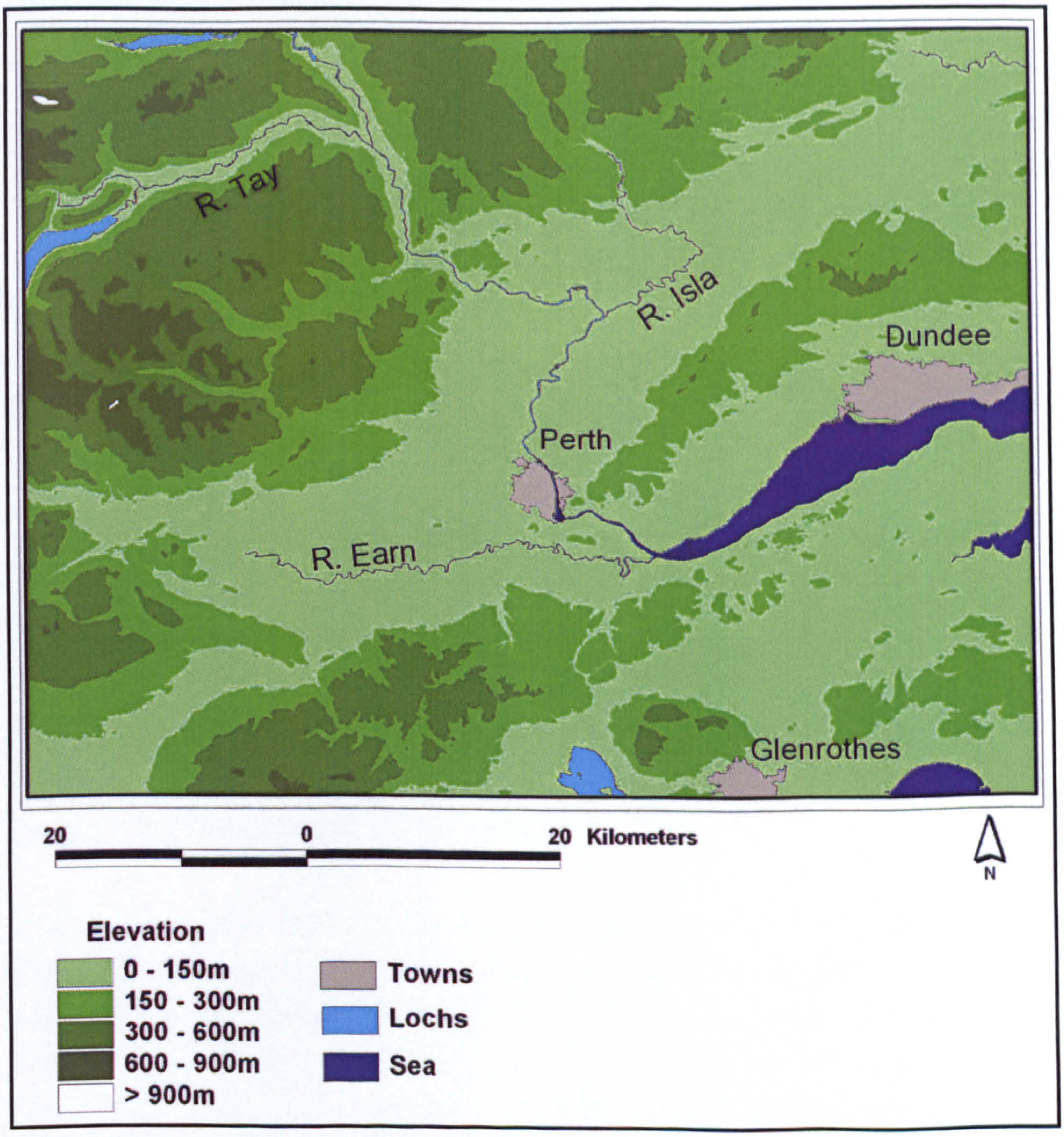

Figure 2.4. Map of the study area showing topography, major towns, lochs and rivers.

The majority (62%) of the land within the study area lies below 200m OD, while only 13% lies above 400m OD. The study area is punctuated by a number of river valleys, the largest of these being the Tay valley, running SSE from its source at Loch Tay to its estuary at Perth, and the River Earn, running E from its source at Loch Earn to the Firth of Tay. A wide range of soil types is present within the study area. Generally, these reflect the underlying drift geology. The NW is dominated by peaty podzols and blanket peats, while the SE half is dominated by brown forest soils derived from carboniferous sandstones, interspersed with smaller areas of humus-iron podzols. Within the main river valleys there are large areas of alluvial soils, and substantial quantities of windblown sands occur at Tentsmuir Forest to the north of St Andrews.

2.2.3 Archaeology

The study area contains a rich yet diverse set of archaeological remains, ranging widely in terms of period, function and construction. As this research is concerned primarily with study of monument loss rather than monument interpretation, no attempt has been made to explore the precise archaeological characteristics of the sample of monuments. However, examination of the NMRS database download obtained for this research in the Autumn of 1999 enables a brief summary. The locations of some of the monuments mentioned are shown in figure 2.5.

Mesolithic remains recorded in the study area are confined to about half a dozen locations. Probably the best known are the settlement sites at Morton in Fife (NMRS no. NO42NE 9), where field survey in the 1950s and excavations in 1969-70 recovered in excess of 13,000 flaked stones over two sites, including end scrapers, burins, awls, microliths, hammerstones, grinding and polishing stones (Coles 1971). Structural remains included hearths and post-holes, and radiocarbon dates obtained suggested use from 8050 +/- 255 to 6115 +/- 110 BP (ibid.).

There are a number of Neolithic monuments in the study area, though these are almost exclusively ceremonial and funerary. They include the exceptionally well-preserved cursus known as the Cleaven Dyke, situated near Blairgowrie in Perthshire (NMRS no NO14SE 80), which stands extant for a length of approximately 1820 metres with a further 350m visible as cropmarks. Elsewhere in the study area, Neolithic activities are represented primarily by monuments such as henges, barrows and standing stones, although recent research by Barclay (Barclay and Maxwell 1999) and excavations by Halliday (2002) suggest that there may be yet further diversity of Neolithic activity evident in the cropmark record.

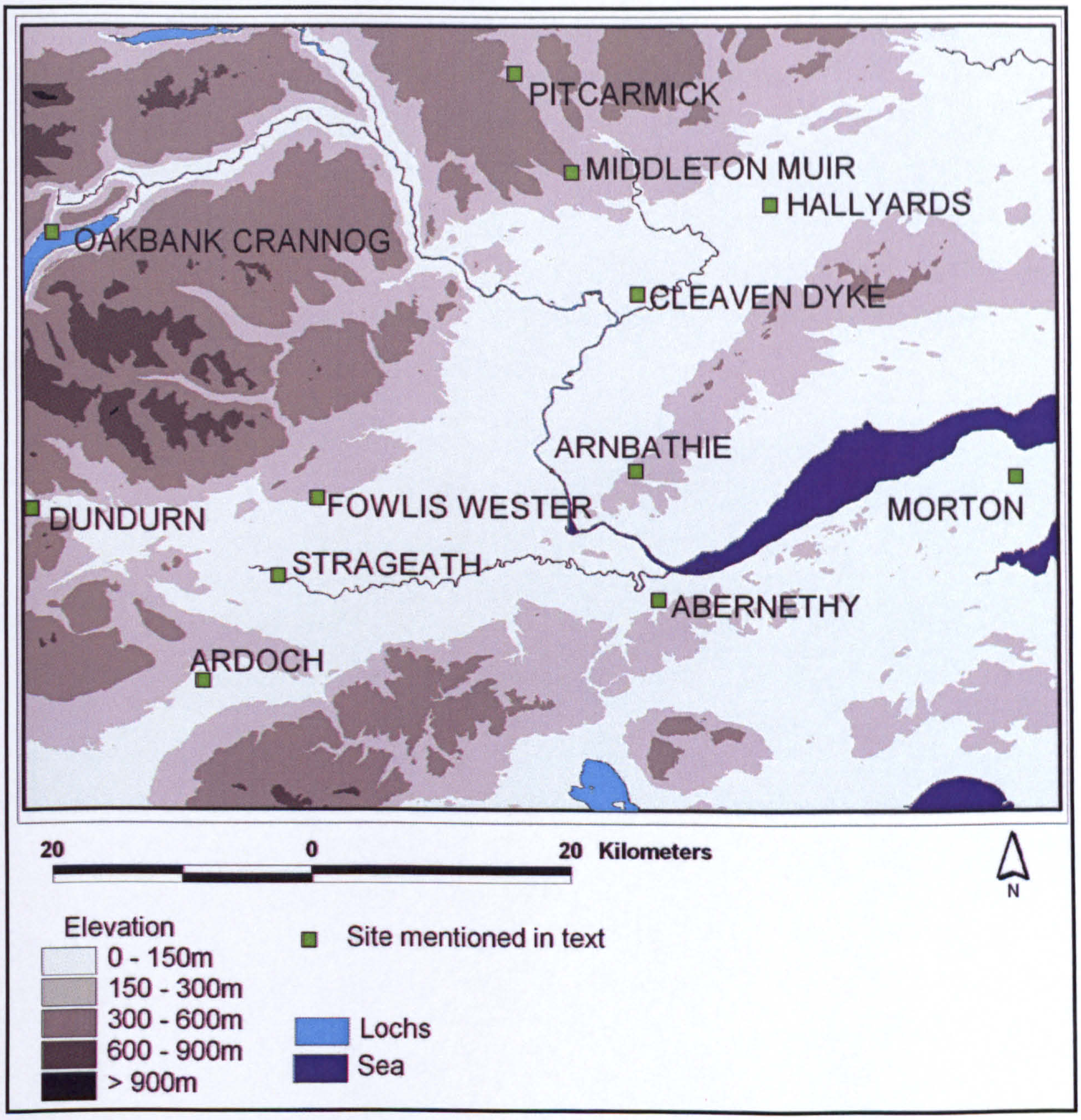

Figure 2.5. Map showing locations of some of the monuments mentioned in text.

The study area contains a large number of domestic sites of Bronze Age date, in the form of hut-circles and associated field systems. These sites are common in upland Perthshire and Angus, and have been recorded in large numbers in Strathardle (including many of the distinctive double-walled 'Dalrulzion type' hut-circles) and at Middleton and Gormack Muirs. In addition to these, Bronze Age burial practices are attested to by the presence of barrows and discovery of numerous short cists and cremation burials.

Iron Age monuments within the study area include upstanding monuments such as hillforts, brochs and 'Glen Lyon type' homesteads. Further diversity among Iron Age settlement in the study area is demonstrated by the presence of crannogs in Loch Tay (including Oakbank – NMRS no. NN74SW 16) and Loch Leven. However, the majority of recorded Iron Age remains recorded are cropmark sites (although it is acknowledged that assigning site function and period cannot always be achieved accurately on the evidence of cropmarks alone). Typically, these include solid disc-shaped cropmarks and ring-ditches, representing the remains of timber roundhouses, as shown in figure 2.6. These sites, commonly known as unenclosed settlements, may include souterrains, distinctive semi-subterranean structures of stone or wooden construction and probably used for storage.

Figure 2.6. Aerial photograph of Iron Age unenclosed settlement at Knockhill, Fife (NMRS no. NO42NW 46). Photo no. C56547. © *Crown Copyright RCAHMS.*

Broadly contemporary with many of the 'native' Iron Age monuments, almost all Roman monuments in the study area are of military origin, including forts, temporary camps and watch towers. Most relate to the Agricolan campaign in the late 1st century AD, though some, such as the temporary camp at Kirkbuddo, Angus (NMRS no. NO44SE 15), are thought to date to the Severan campaigns of the late 3rd century. Many of the Flavian sites, including a series of signal stations or watch towers on the Gask Ridge (Woolliscroft 1993, 2002a), are concentrated along the Roman Road which runs between the forts at Ardoch (NN80NW 10), Strageath (NN81NE 2) and Cargill (NO13NE 27), as illustrated in figure 2.7.

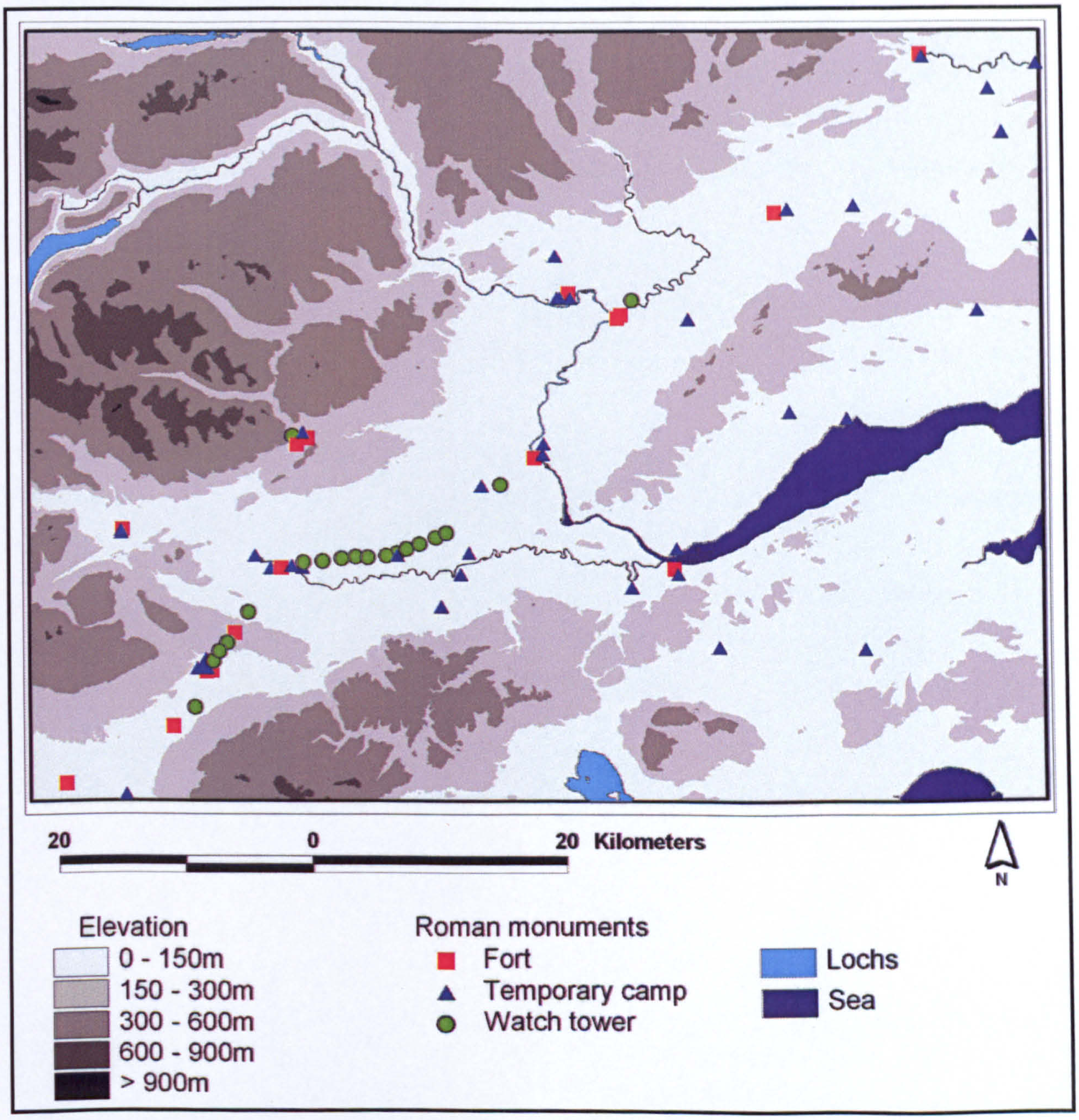

Figure 2.7. Distribution map of Roman forts, temporary camps and watch towers in the study area.

Later Iron Age or Early Historic monuments within the study area include square barrows and other characteristic monuments of the Pictish period such as carved symbol stones. The study area also contains the fort of Dundurn (NN72SW 3), a nuclear fort thought to have been a Pictish stronghold in the 7th century (Alcock *et al.* 1989), and a Pictish cemetery at Lundin Links, Fife (NO40SW 13). Many of the Pictish symbol stones have been found in association with early churches and other medieval sites such as Dunkeld Cathedral (NO04SW 1), which has been an ecclesiastical site since at least the 9th century, and the Abernethy Round Tower (NO11NE 1), which dates to the late 11th century. Other later church sites in the study area have been found to have Pictish associations, such as the churches at Fowlis Wester (NN92SW 7) and Benvie (NO33SW 6). Although relatively recent structures, the presence of Pictish symbol stones at these churches suggests long-term continuity in the use of the same sites. Lower status sites of this period found in the study area include longhouses at North Pitcarmick dated to the 7th and 10th centuries AD (Barrett and Downes 1993; 1994).

In addition to early church sites, the study area contains many other medieval monuments, including high-status defensive sites such as Leuchars Castle, a motte of 13th century date (NO42SE 5), Hallyards, a moated site thought to date to at least the 16th century (NO24NE 9), and deer parks such as at Middleton Muir in Perthshire. Lower status monuments of possible medieval date include the fermtoun at Arnbathie (NO12NE 48). Indeed, the study area contains an abundance of Medieval or Later Rural Settlements (MoLRS), many of which remained at least partially roofed at the time of the Ordnance Survey 1st Edition mapping in the 1860s. Other post-medieval monuments include the remains of extensive field systems and shielings, such as the example shown in figure 2.8.

Figure 2.8. Shieling at Loch Farleyer, Perth and Kinross (NMRS no. NN85SW 48).

2.2.4 Land cover

The archaeological record of the study area is set within a landscape which, owing to the wide variation in topography and soil types, contains a wide range of land cover types. The LCS88 shows that the arable land (accounting for approximately 42% of the land area) is predominantly in the low-lying, well-drained areas in the east of the study area, as shown in figure 2.9.

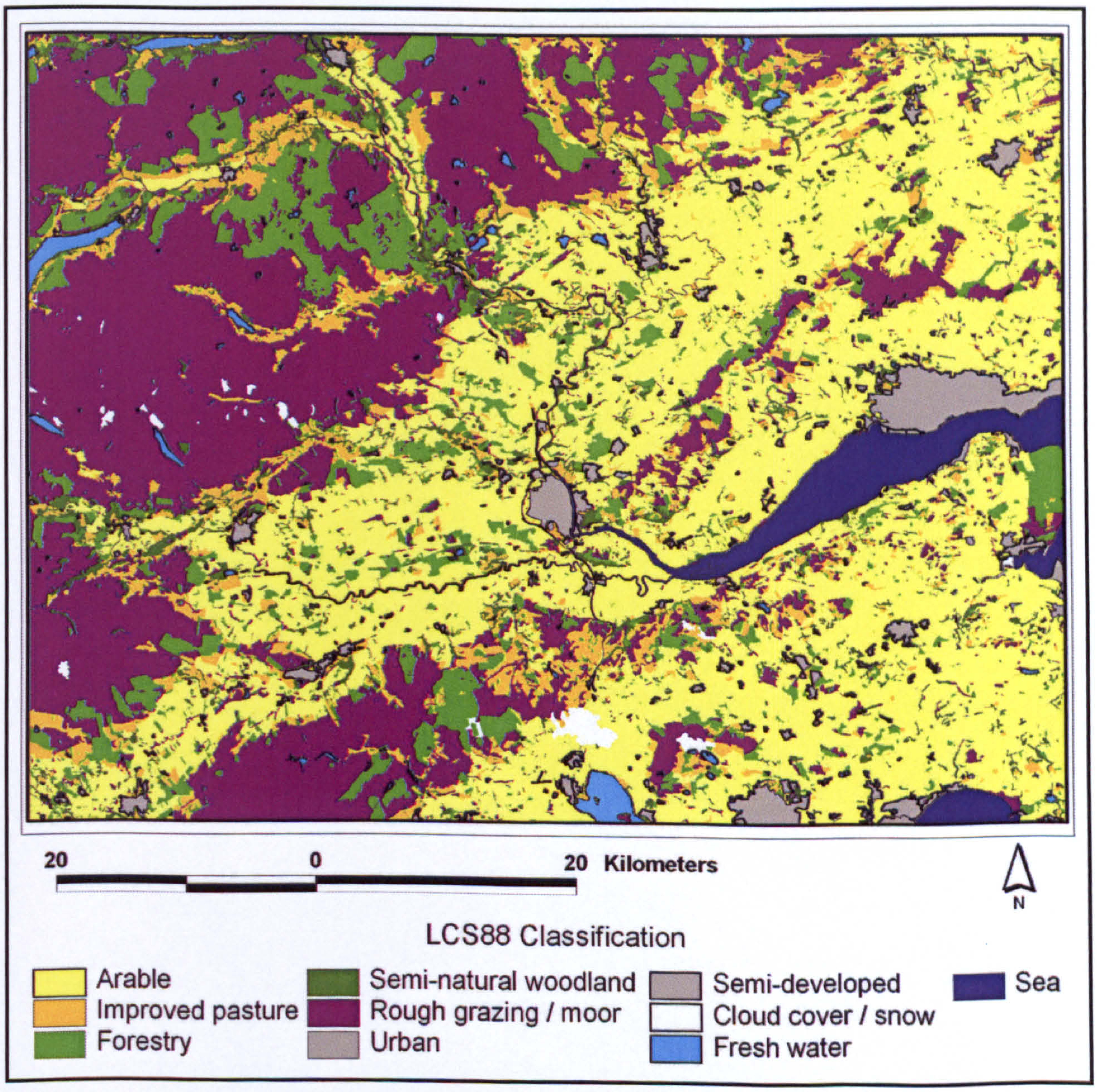

Figure 2.9. Map of land use within the study area according to the LCS88 (MLURI 1993).

Non-intensive land uses such as heather moorland and unimproved grazing (accounting for a further 31% of land area) predominate in the west and north-west of the study area, where the topography restricts the agricultural productivity of the land. Forestry is dispersed throughout the study area, accounting for approximately 9% of the land area, though large plantations are confined mostly to the NW corner of the study area around Dunkeld and Aberfeldy. The remainder of the study area is split between semi-natural woodland (about 5% of the land area), improved pasture (about 8% of the land area) and developed land, which makes up about 3% of the land in the study area.

2.2.5 Land cover change

Although some specific trends in land cover change within Scotland and the UK have been discussed in chapter 1, none of these trends have pertained specifically to the land which makes up the study area of the recent research. Data from the National Countryside Monitoring Scheme (Mackey *et al.* 1998) and Agricultural and Horticultural Census (SEERAD 1939-99) demonstrate three distinct trends in land use change within in the study area since the 1940s:

1. The study area saw an overall increase in cultivated area up to the late 1980s, coupled with the removal of many field boundaries. This increase in cultivated area stopped in the late 1980s, and has been in slow decline since.

2. There has been a gradual increase in the overall area of commercial forestry, coupled with drainage of uplands for new planting.

3. There has been a steady decline in the overall area of non-intensive land uses such as rough grazings and heather moorland, primarily at the expense of forestry.

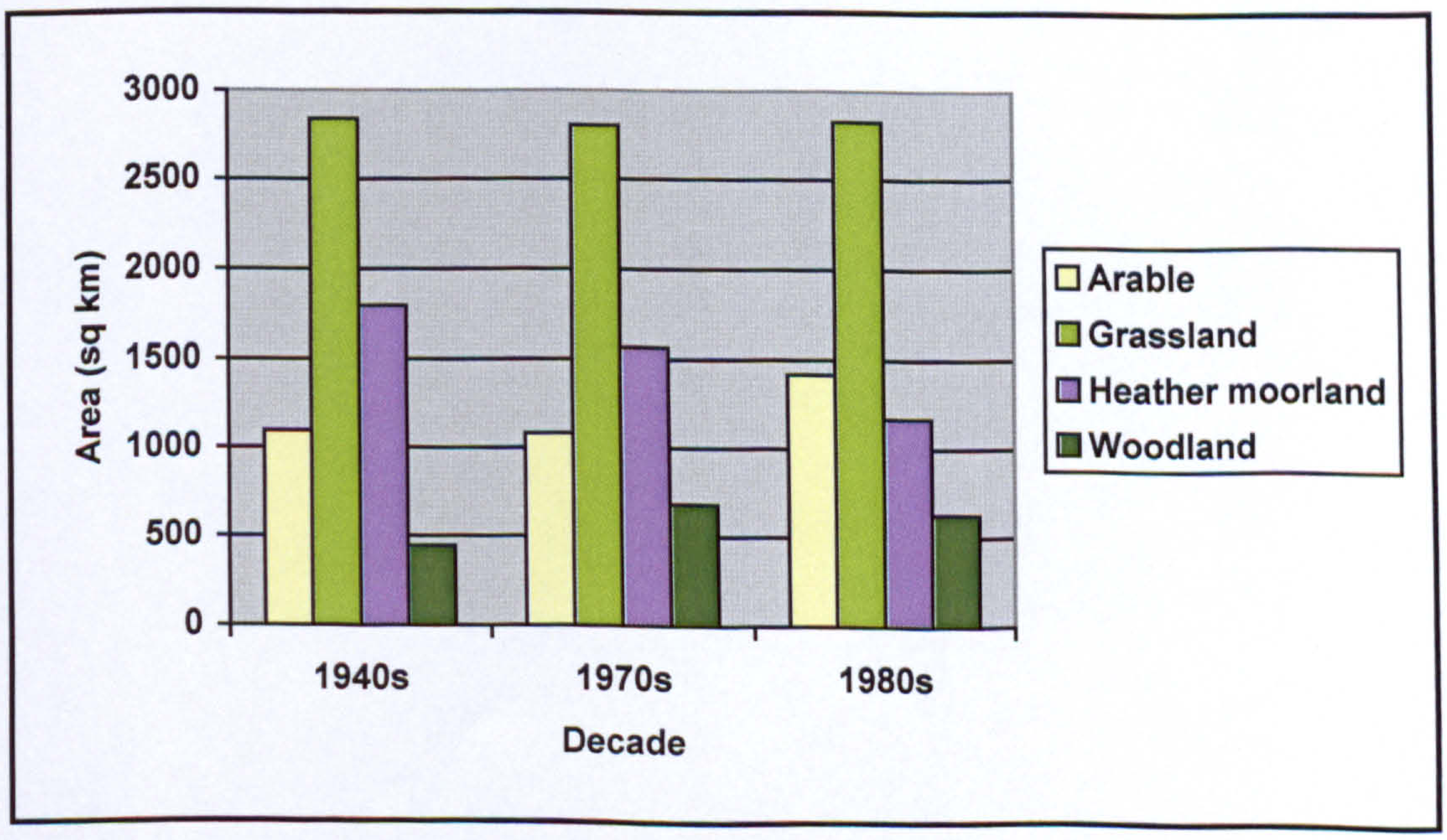

Figure 2.10. Chart showing NCMS land cover in Tayside 1940s – 1980s.

While no precise statistics exist to demonstrate these trends for the whole study area, figure 2.10 illustrates these trends within Tayside, the former unitary authority area making up the majority of the study area. Figure 2.10, showing NCMS figures for land utilisation in Tayside, shows an increase in the area of arable land from 1095 square km in the 1940s to 1420 square km in the late 1980s, coupled with a steady decline in the total area of heather moorland. This steady intensification of land use in agricultural land is further demonstrated by a reduction in the overall length of hedgerow, from 3944km in the late 1940s to 1444km in the late 1980s, as shown in figure 2.11.

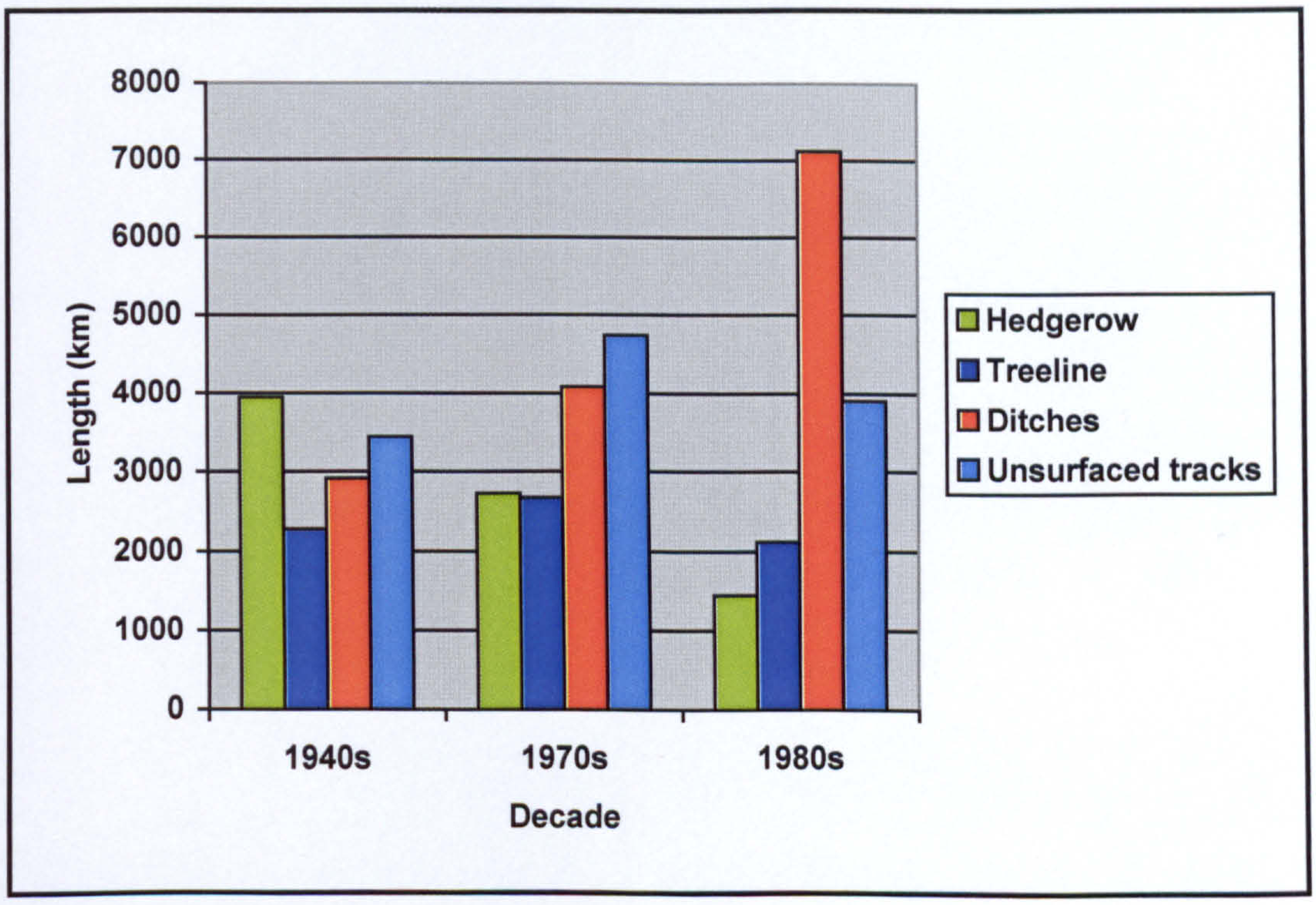

Figure 2.11. Chart showing NCMS linear features 1940s – 1980s.

Data from the Agricultural and Horticultural Census for an area closely analogous to the full extent of the study area (this data is available by parish area, and so data for the precise extent of the study area could not be obtained) illustrates the minor reversal since 1989 in the overall trend of land use intensification. This has occurred in response to changes in the Common Agricultural Policy, which has placed greater emphasis on environmental management since the late 1980s. Although figure 2.10 shows a slight decrease in the overall area of woodland between the early 1970s and late 1980s, within this category, the area of coniferous plantation has doubled in extent while the area of mixed woodland experienced a drop in extent of over 50%. This increase in total area of forestry is further illustrated by examining changes in the extent of linear features within Tayside shown in figure 2.11. These show a marked increase in the length of ditches recorded in Tayside, from 2913km in the late 1940s to 7121km in the late 1980s. This increase reflects an increase in the drainage of upland areas in advance of planting of forestry. The Agricultural and Horticultural Census data, like the NCMS data, further demonstrate the steady decline in the area of rough grazings from 1970 to 1999. While some of this reduction represents rough grazings that have been converted to grassland, it is likely that the bulk of the drop reflects land that has been sold for commercial forestry.

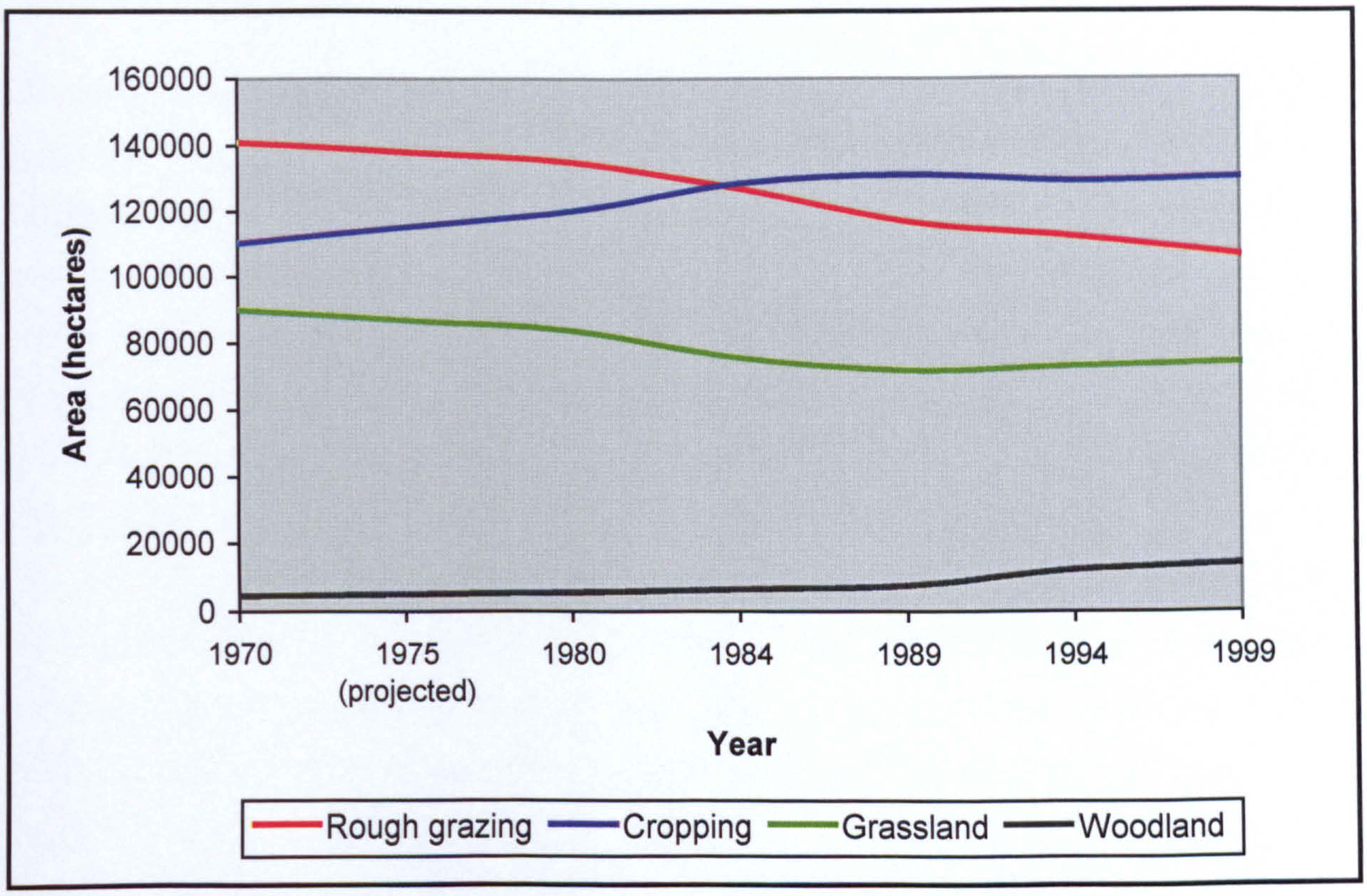

Figure 2.12. Agricultural and Horticultural Census data showing land cover change within area analogous to study area, 1970 – 1999.

While the NCMS, Agricultural and Horticultural Census and the National Inventory of Woodland and Trees demonstrate trends in land use change within in the study area since the 1940s, before 1940, statistics relating to land cover change are available only for the whole of Scotland. Data from the Agricultural and Horticultural Census (which are available as far back as 1866) show that the area of tillage in Scotland peaked at 2,165,000 acres in 1872 and went through a period of steady decline until 1914, when the area of tillage was approximately 1,814,000 acres. Although the area of tillage increased greatly during the 1914-1918 war, it thereafter went into another period of steady decline, reaching a trough of 1,480,000 acres in 1939. After another sharp increase between the years 1939 to 1944, the area of tillage diminished again into the 1960s (MAFF 1968). While this demonstrates that the area of tillage in

Scotland since the late 19th century has seen considerable fluctuation, it is worth noting that according to the data from the Agricultural and Horticultural Census, the total area of tillage during the peak in the 1980s was only about 80% of the tillage area recorded during the 1940s (SEERAD 1939-99), which, in turn, was slightly less than the area of tillage recorded in Scotland during the peak of the late 1860s and 1870s (MAFF 1968, 95). The agricultural census data thus suggests that even at its peak in the 1980s, total tillage area in Scotland was significantly less than it had been at the peak during the 1860s and 1870s.

It is possible to identify trends in the area of woodland within Scotland since the 19th century, but precise quantification of change in woodland area is more difficult. The National Inventory of Woodland and Trees (Forestry Commission 2001a, 47) shows that the area of woodland in Scotland was broadly stable between 1870 and 1940, rising from just over 4% of land area in 1870 to about 6% in 1940. Thereafter, the proportion of Scotland under woodland increased to about 8% in 1960, 12% in 1980, and stood at about 17% in the year 2000. In Tayside (the former Regional Authority area making up the bulk of the study area), although the area of woodland is not quantified before 1980, examination of planting patterns from 1861 onwards reflects the national increase in woodland area. Between 1861 and 1900, about 1300 hectares of woodland were planted in Tayside, although the majority were broadleaves. Planting in the decades prior to 1940 remained at below 2000 hectares per decade, but in the 1940s, this figure increased to nearly 4000 hectares. Thereafter, planting increased to nearly 11,000 hectares in the 1950s and peaked at nearly 18,000 hectares in the 1960s. Planting declined in the 1970s to about 10,500 hectares before increasing again to about 16,000 hectares in the 1980s (Forestry Commission 2001b, 13). Although the National Inventory of Woodland and Trees shows that planting between 1990 and 1995 was vastly reduced when compared with the planting in the 1980s, the recent "Forests for Scotland – The Scottish Forestry Strategy" (Scottish Executive 2000) has stated that the woodland and forestry cover in Scotland should be increased from its current 17% to around 25% in the next 50 years, suggesting that significant planting programmes have yet to be embarked upon.

As with agricultural land and forestry, it is difficult to determine precise changes in the area of built and developed land within the study area since 1850. However, examination of NCMS data for Tayside and Fife provides an indication of trends in the latter half of the 20th century. Figure 2.13 shows areas of built land and transport corridor in Tayside and Fife in the 1940s and 1980s, and shows that although the area of developed land is minor when compared with farmland, built land and transport corridor area increased by about 23% in Tayside and 34% in Fife.

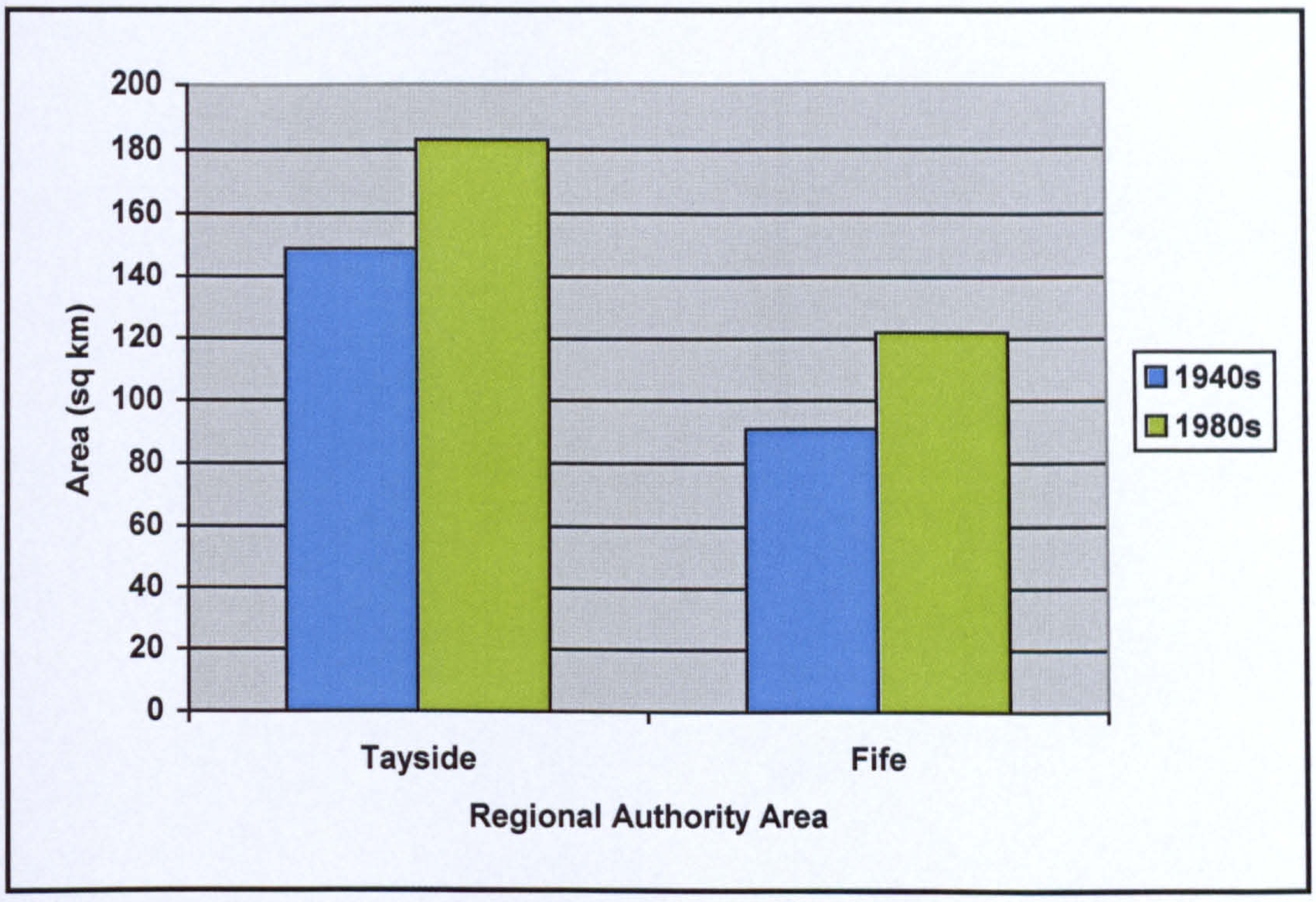

Figure 2.13. Chart showing increases in built land and transport corridor in Tayside and Fife 1940s – 1980s, as recorded by the NCMS.

The scale of the increase in built land since the 19th century is demonstrated though comparison of urban centres as portrayed in the Ordnance Survey 1st Edition mapping of the 1850s and 1860s and the extent of these urban centres in the LCS88. Table 2.2 shows approximate areas of four towns or cities within the study area in the 1860s (calculated using Arcview GIS) and in 1988.

Town / City	Area in OS 1st Edition mapping (sq km)	Area in LCS88 (sq km)	Percentage increase in area
Dundee	8.2	43.3	530
Perth	2.3	14.1	622
Forfar	0.8	4.4	553
Aberfeldy	0.17	0.78	470

Table 2.2. Areas of four population centres at time of Ordnance Survey 1st Edition mapping and LCS88.

As table 2.2 shows, the total area of these town and cities has increased about five-fold since the Ordnance Survey 1st Edition mapping. As the NCMS suggests that built area has increased by a much lesser extent since the 1940s, it is fair to assume that much of the increase in developed land occurred between the 1860s and the 1940s. The area of increase is illustrated further in figure 2.14, which shows 1st Edition mapping of Aberfeldy in Perthshire and the extent of the urban area as mapped in the LCS88.

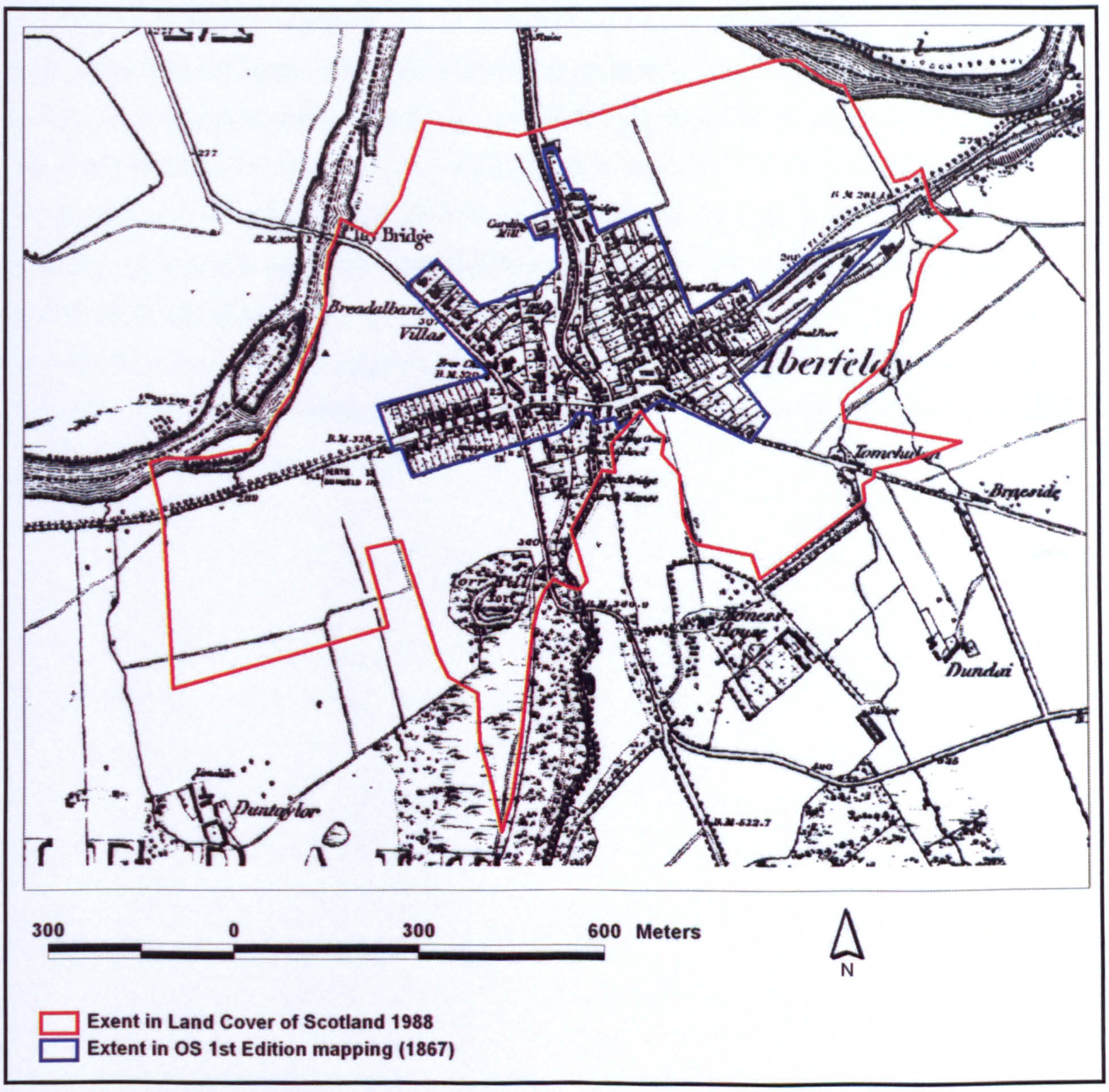

Figure 2.14. Map showing the extent of Aberfeldy in Ordnance Survey 1st Edition mapping ((1867) © Crown copyright and Landmark Information Group Ltd) and in the Land Cover of Scotland 1988 (MLURI 1993).

As discussed in chapter 1, evidence from elsewhere in the UK has shown that these trends in land use change in the latter part of the 20th century have had negative implications for the archaeological resource. The general expansion in the overall cropping area over the past five decades has seen the new cultivation of more marginal tracts of land, the ploughing up of established grassland, and the drainage and cultivation of fenland. This has resulted in significant monument loss in England (e.g. Hinchcliffe 1980; Canham *et al.* 1980; Simmons 1980). Furthermore, the expansion of forestry at the expense of heather moorland and rough grazing has seen the damage or loss of large numbers of monuments (e.g. Jackson 1978; Mercer 1980; Dunbar 1989). Finally, MARS has demonstrated the effects of development on the archaeological resource, finding that development and urbanisation were responsible for 27% of observed cases of monument destruction and 9% of piecemeal monument loss (Darvill and Fulton 1998). However, the majority of the evidence described above has been recorded outside the study area. Within the study area, although there are recorded cases of monument loss attributable to agricultural expansion and intensification, forestry and urbanisation, no audit has yet been attempted, and consequently, such cases remain anecdotal evidence. It is vital, therefore, that systematic and statistically founded data pertaining to the effects of these land use changes on the archaeological resource within the study area should be collected, analysed and disseminated. As stated in section 1.1, the present research is the first such project in Scotland to achieve this.

2.3 Detailed research objectives and framework

2.3.1 Research objectives

The overarching research aims defined in section 1.6 have provided the basis for more specific research objectives. These specific objectives have been in part determined by the data sources available for interrogation, and all pertain to the identification of patterns in monument loss within the study area since 1850. However, in all aspects of the desk-based study, because of the wide range in data types collected and the potential for inaccuracies in many, no hypotheses have been tested and no statistical tests have been applied. Instead, descriptive methods of analysis have been employed to produce frequency distributions and cross-tabulations from the data collected through the desk-based study. These results have then been calibrated using the results of the accuracy assessment, using simple techniques described in sections 3.5 and 4.3. Although for a variety of reasons, the calibrated results produced cannot be treated as precise, they do present a more detailed and accurate account of patterns in monument loss within the study area since 1850.

The first of the overarching research objectives defined in section 1.6 is the creation of a sample-based census outlining the current state of archaeological monuments within the study area. This census is described in chapter 3, and summarises the current perceived distribution of field monuments within the study area. It should be emphasised that the census is sample-based, and as such, is not a complete inventory of the archaeological record within the study area. Specifically, this census examines

1. Distribution and numbers of monuments according to their period of construction.

2. Distribution and numbers of monuments according to the land use in which they are situated.

3. Distribution and numbers of monuments according to their original materials of construction and their current status either as cropmark or non-cropmark sites.

4. Distribution and numbers of monuments according to altitude.

5. Distribution and numbers of monuments according to their status as scheduled or unscheduled monuments.

6. Monument distribution according to Land Capability for Agriculture classification.

These variables have been examined in relation to monument distribution for a number of reasons. A shift in recent years towards understanding monuments not in isolation but within their wider landscape settings has seen an increase in the analysis of monument distribution patterns (e.g. RCAHMS 1990; 1994). The recognition and understanding non-archaeological factors influencing distributions of monuments is vital if archaeological distributions are to be understood properly. For example, Cowley (2002, 255) has argued that the results of aerial survey are often abused in synthesis, with little assessment or understanding of potential biases in data collection, despite a continued concentration of target-driven survey in 'honey pot' areas where high returns are guaranteed. Ray and Chamberlain (1985) have discussed the importance of peat depth in determining perceived distributions of monuments in peatland, while Stevenson (1975) has discussed the importance of land use on the survival and discovery of monuments, particularly among buried features such as cists and souterrains. Halliday (1990), meanwhile, has highlighted the importance of the individual surveyor in influencing the recording of archaeological monuments, pointing out that archaeologists have a tendency to record features within the limits of their experience and expectation. By examining non-archaeological variables outlined, the census has been designed to identify non-archaeological factors which might have affected or biased perceived monument distributions.

The second and third overarching research objectives outlined in section 1.6 (the quantification and analysis of changes in monument condition and the identification and evaluation of the processes responsible for these changes) are closely intertwined, and so have been treated together during the desk-based study. In addressing these research objectives, the desk-based study has addressed the following themes:

1. What have the impacts of land use and land use change been on the monuments within the study area since 1850?

Land use has long been identified as having a significant impact on the condition and preservation of monuments (e.g. Darvill 1987; Darvill and Fulton 1998, 146). Furthermore, changes in land use impact upon monuments, with changes to areas of forestry (e.g. Jackson 1978; Proudfoot 1989), arable land (e.g. Hinchcliffe and Schadla-Hall 1980) and developed land (e.g. Darvill and Fulton 1998) having accounted for significant levels of monument loss. As described in section 2.2.5, the areas of woodland and developed land in the study area have both increased markedly over the past 150 years, while the area of arable land has fluctuated, with notable peaks in the 1872, 1918, 1943 and 1989. Given the changes in land use and the impacts these changes have had elsewhere, this research has sought to examine their effects in eastern central Scotland.

2. From existing data sources, is it possible to discern specific *episodes* of monument loss in the study area? If so, what has caused these episodes?

The review of literature presented in the previous chapter has identified a number of factors which have been to the detriment of the archaeological resource. In particular, development, forestry and farming appear to have had a significant impact elsewhere in the UK since the 1940s. The present research has sought to identify whether such episodes are reflected in eastern central Scotland also.

3. Based on the data sources available, is it possible to identify differences in the survival of monuments according to the Local Authority area in which they are situated?

Levels of archaeological input to the planning process within each of the three main local authority areas within the study area have differed over the past 15 years. In Fife, the local archaeologist was appointed in 1989, while in Angus, this service has been provided from an adjacent local authority (Aberdeenshire) since 1996-7. Finally, the local archaeologist in Perth and Kinross was appointed only in the year 2000. The present research has sought to identify variations rates of monument loss between local authority areas that might be attributable to these differing levels of archaeological input in the planning process.

4. How does monument condition change since 1850 relate to Land Capability for Agriculture classification?

Land Capability for Agriculture (LCA) summarises the character of land and its suitability for agriculture. As studies such as MARS and the *Management of Archaeological Sites in the Arable Landscape* project have shown, intensive agriculture has accounted for a significant quantity of monument loss. Furthermore, loss of agricultural land through development is primarily in areas where the agricultural land value is highest (Davidson 1992). Holderness (1985, 150) has noted that most of the British New Towns of the 1950s and 1960s were built on good quality agricultural land. The New Town of Glenrothes is situated at the southern edge of the study area. In examining monument loss in relation to LCA, this research has sought to establish whether these relationships between good agricultural land, intensive faming and development pressure are reflected in the archaeological resource within the study area.

5. How does monument condition change since 1850 relate to the altitude at which monuments are situated?

As with LCA classification, elevation has a significant bearing on land use. At low altitudes, arable agriculture and developed land predominate, while higher altitudes are generally occupied by less intensive land uses such as rough grazing and heather moorland. In this research, monument loss is examined in relation to elevation in order to illustrate further the types of threats posed to the archaeological resource in different landscape settings.

6. Is it possible to identify variations in long-term survival of monuments that might be attributed to the materials from which they are constructed?

MARS has shown that rates of monument loss in England have varied according to monument form and construction type, with loss highest among landcuts (such as ponds, quarries, wells and mineshafts) and lowest among earthworks (Darvill and Fulton 1998, 110). Similarly, this research has sought to identify any disparities in monument survival that might be attributable to material construction.

7. How does monuments condition change since 1850 relate to the period of construction of sample monuments?

MARS found that rates of loss among MARS monuments varied according to period, with loss highest among palaeolithic, neolithic, Roman and medieval monuments (Darvill and Fulton 1998, 113). This research also examines monument loss according to monument period.

8. Is there a noticeable difference in current condition patterns of scheduled and unscheduled monuments? If so, to what extent are these differences attributable to scheduling?

As described in section 1.3, scheduled ancient monuments are afforded statutory protection. Consequently, it might be expected that rates of loss among scheduled monuments will have been lower than among unscheduled monuments. MARS found this to be the case, finding that rates of loss among unscheduled monuments were significantly higher than among scheduled monuments (Darvill and Fulton 1998, 199).

These objectives, like those driving the census, have not been designed to provide new and groundbreaking information to further any specific area of archaeological resource management. Rather, they have been designed to enable the increased general understanding of patterns in monument loss within the study area since 1850. Consequently, the results produced should help inform resource managers and archaeologists alike, providing statistics on monument distribution and loss and identifying those factors that have contributed most.

The final overarching research objective outlined in section 1.6 (the assessment of the implications of the results in ongoing and future archaeological resource management) is not addressed directly through the desk-based study, and consequently, discussion presented in chapters 3, 4 and 5 is limited. Instead, this objective is addressed in chapter 7, when the findings of the census, desk-based study and excavation programme are drawn together to enable general conclusions, discussion, and recommendations for future research.

2.3.2 Research framework

The framework around which the census and desk-based study has been based is illustrated in figure 2.15.

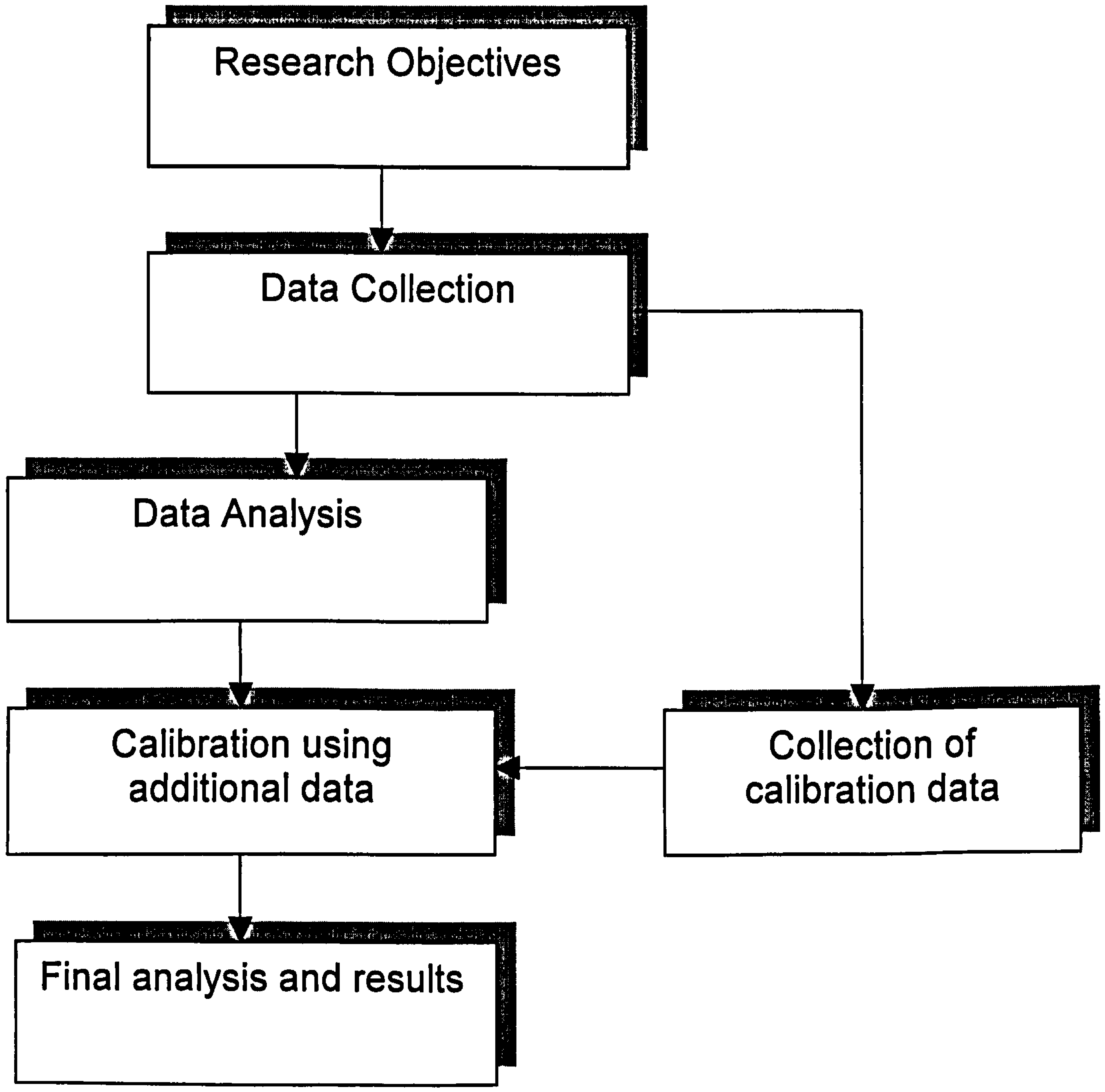

Figure 2.15. Flow-chart showing the framework upon which the desk-based study has been based.

As figure 2.15 shows, the data collected (section 2.5) have been driven by the specific research objectives outlined in section 2.3.1. These data have then been analysed to produce rough statistics on monument distribution (through the census) and monument loss in relation to a number of environmental variables, including land use, elevation, LCA classification and local authority area. These results have then been calibrated using the results of an accuracy assessment, enabling a more accurate portrayal of monument distribution and patterns in monument loss to emerge, and conclusions to be made.

2.4 Sampling

A copy of the NMRS database for the entire study area was obtained in October 1999, but of the 13,537 records it contained, most were found not to be practical for use in the current research. To ensure that the entries kept referred to monuments that would enable research aims to be addressed, the following filters were applied:

1. All monuments destroyed before 1850 were rejected.

2. All monuments moved since 1850 were rejected. As outlined in section 2.3, one of the variables examined in this research in relation to monument loss is land use. If moved from one location to another (or indoors, as is the case with many of the carved stones in the study area), a monument becomes divorced from the environmental conditions it was previously subject to, and so analysis of the effects of variables such as land use would become impossible.

3. Any monuments constructed since 1850 were rejected. Again, any change in the condition of a monument since 1850 cannot be determined if the monument was not in existence at 1850. This, unfortunately, meant the exclusion of all 20th century military remains.

4. Any monuments identified from maps but not verified through field survey or aerial photography were rejected.

5. Any monuments occupied since 1850 were rejected. This filter was difficult to enforce, as some of the MOLRS in the study area (although recorded in the NMRS) are still occupied. Monuments re-used for non-domestic purposes (such as dovecots or houses converted to byres) were retained.

Table 2.3 shows a breakdown of all NMRS entries obtained, and numbers of records rejected from the population of monuments before a sample was extracted for use in the desk-based study.

Reason for inclusion or rejection	Number of Records
Suitable for desk-based study	4637
Insufficient description	3330
In use / occupied	1327
FESP sites without subsequent field survey	996
Insufficient locational information	885
Stray find	820
Destroyed before 1850	431
Natural / of dubious authenticity	399
Other	712
TOTAL	**13537**

Table 2.3. Table showing numbers of monuments rejected from population before sampling began.

As table 2.3 shows, the filters outlined above account for the rejection of some 2800 entries. A further 996 rejected entries refer to monuments identified in the First Edition Survey Project (FESP) but which have never been verified in the field. Most of the other NMRS entries rejected (over 4000 in total) were rejected as there was insufficient information on the nature, extent or location of the monument concerned. Of the 712 entries rejected for miscellaneous reasons (categorised as 'other' in table 2.3), over 300 were rejected because although they did not technically 'fail' the filters, they were simply not suitable for inclusion in the present research. These records included railway stations, quarries and other predominantly urban industrial structures. This category also included many recorded archaeological remains exposed by development in urban areas, as the total extent of such remains can seldom be defined. Every effort was made to retain entries referring to cropmark monuments, even though most of these have no written description in the NMRS. Any cropmark record with some level of archaeological interpretation was retained. Those rejected were of non-archaeological classification such as 'linear cropmarks' and 'linear features'.

From the group of 4637 NMRS records remaining after the application of the filters outlined above, it was necessary to extract a sample for inclusion in the desk-based study. It was felt that a figure in the region of 800 monuments would be sufficiently large to be statistically valid, yet small enough to be manageable. In the event, a 17% sample totalling 787 records was extracted. Over the course of the research, eight of these 787 monuments were dropped from the sample, giving a final sample for analysis of 779. The eight records were dropped for a variety of reasons. Two did not contain sufficient locational information, two referred to structures that had been moved, two referred to modern or occupied structures, one referred to a monument that had been destroyed prior to 1850, and one referred to a monument with an identical 6-figure grid reference to another monument in the sample. These were all records that should have been rejected at the initial filtering stage of the sampling process, but had been overlooked through human error. These eight records represent approximately 1% of the initial sample.

A stratified random sampling technique was employed, designed to ensure that the final sample to be used in the research was an accurate representation of the overall population, not only in terms of location, but also in terms of the ages of the monuments represented. This was ensured by splitting the study area into eight sectors, as shown in figure 2.16. Within each of the sectors, counts were made of the period of the monuments (prehistoric, Roman, medieval, post-medieval and unknown) and whether these monuments are cropmark or non-cropmark sites. Using these counts, it was possible to ensure that the numbers of monuments in the extracted sample were representative of the overall population of monuments both in terms of monument period and according to status as cropmarks and non-cropmarks.

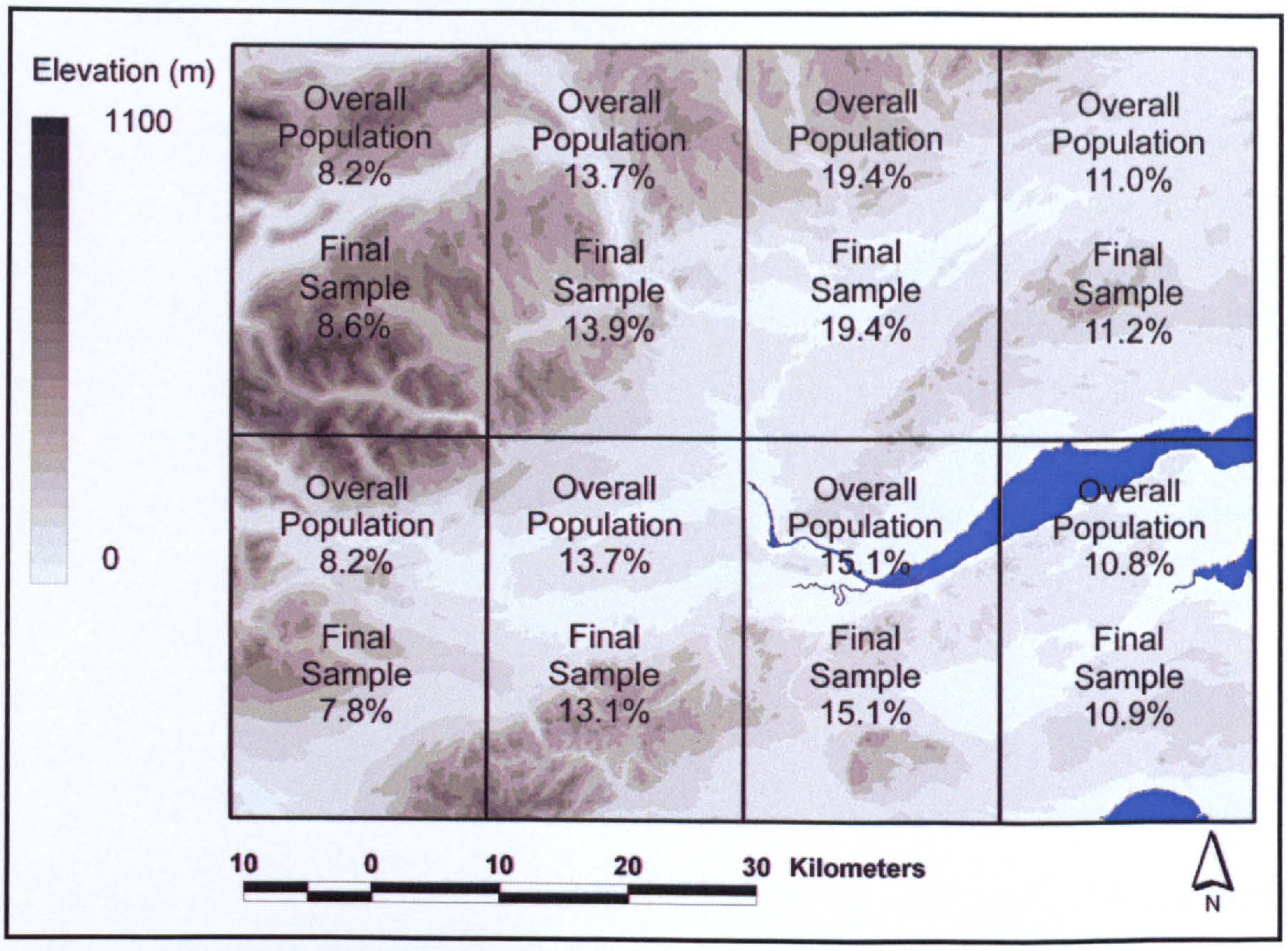

Figure 2.16. Map of the study area showing proportions of monuments in the overall population of monuments and final sample of monuments.

A random selection tool in Arcview GIS was used to extract the sample of monuments for each sector. During the sample extraction, attempts were made to ensure that monuments in the sample were not situated within close proximity of each other. This was done to attempt to eliminate cases where more than one monument may have been destroyed by a single event, such as quarrying or forestry, causing biases in the data produced for analysis. In some cases, however, it was unavoidable that clusters of sites would occur, owing to the nature of the population of monuments from which the sample was extracted. The final sample of 779 monuments used in the desk-based study is listed in Appendix A.

2.5 Data extraction, interpretation and analysis

Varying methodologies were employed during the desk-based study to extract, interpret and analyse data. Although each was designed to maintain high levels of objectivity and consistency, both in the data extracted and their subsequent analysis, it was inevitable that a degree of subjectivity would be introduced due to the nature of the data sources used. Data for some variables, such as altitude and local authority, were found to be easily obtainable, and could be analysed in the form they were extracted from source. However, data obtained for other variables, such as land use and monument condition, required interpretation and categorisation before they could be analysed.

2.5.1 Monument condition information

Monument condition information was determined through the examination of NMRS records. As described in section 2.1, for many of the sample monuments, the NMRS contains a series of short reports describing the monument at various dates. These reports usually refer to the dimensions and archaeological interpretation of the monument, but occasionally, they make reference to damage and / or changes in the extent or condition of the monument. An example of an entry of this type is as follows:

> **"Cowford, standing stone**
>
> NO03SE 5 0563 3205.
>
> (NO 0563 3205) Standing Stone (NR)
> OS 6" map (1901)
>
> This stone is now prostrate, having fallen in 1908. It is 5' x 2'2" x c.2ft in thickness. The northern part rests on a small slab-like stone.
> F R Coles 1911
>
> There is no trace of this stone.
> Visited by OS (WDJ) 10 March 1969"

By tracing such records in the NMRS, it has been possible to create condition histories for each of the monuments in the desk-based study. The categories of monument condition used in these condition histories are as follows:

1. Extant and undamaged since 1850. This condition category applies to all upstanding monuments where no damage has been identified as having occurred since 1850.

2. Extant, but reduced (damaged) since 1850. Where damage has been identified, its cause and date have been recorded (where possible).

3. Formerly extant (since 1850), now reduced to invisibility, destroyed or presumed destroyed. This category applies to any monuments known to be extant at 1850, but have since been damaged to such an extent that no above-ground features survive, or the monument has been confirmed completely destroyed or is assumed to be destroyed on the basis of professional survey by the RCAHMS or Ordnance Survey.

4. Formerly extant (since 1850), now cropmark. This category applies only to a few monuments, extant at 1850 but subsequently reduced to cropmarks.

5. Cropmark, undamaged since 1850. This category is a slight misnomer, as many archaeologists would argue that no cropmark monument is an undamaged monument. However, this agricultural damage is seldom possible to identify (chapter 6). This category applies therefore to any cropmark monument for which no *visible* damage (such as road building or other development) can be ascertained to have occurred since 1850.

6. Cropmark, reduced (damaged) since 1850. This category applies to cropmark monuments *visibly* damaged by processes such as development. Technically, this category would include visible agricultural damage to a cropmark monument, but in the entire sample, no such case has been recorded in the NMRS.

7. Formerly cropmark, now destroyed or presumed destroyed. This category refers to any cropmark known or presumed to have been completely destroyed.

8. Buried feature, undamaged since 1850. This category applies to any non-cropmark buried feature (such as a cist or souterrain) for which no *visible* damage can be ascertained to have occurred since 1850.

9. Buried feature, reduced (damaged) since 1850. This category applies to non-cropmark buried features such as cists and souterrains *visibly* damaged since 1850.

10. Buried feature, now destroyed or presumed destroyed. This category refers to any non-cropmark buried feature known or presumed to have been completely destroyed.

Where damage to a monument was recorded in the NMRS but the date of this damage could not be identified accurately, aerial photographs and maps of various dates were consulted. Even with the use of aerial photographs and maps, however, many of the damage episodes recorded remained undated. In such cases, it was necessary to note the last dated NMRS description of the monument before the damage or loss had been identified as well as the date of the NMRS description in which the damage had first been identified. This then provided a date range within which damage had occurred.

In interpreting monument condition, a number of assumptions were made:

1. it was assumed that the condition of a monument remained unchanged between 1850 and the first time it was recorded. This applied to extant sites and cropmark sites, so that even if a monument was first recorded in 1989, it had to be assumed that the monument's condition had remained unchanged since 1850.

2. Similarly, it was assumed that the last recorded condition of the monument (even if this was in the 1950s or 60s) would remain unchanged to 1999.

3. If no text record existed for a monument (as is often the case with cropmark monuments), it was assumed that the condition was undamaged.

4. Unless evidence was presented in the NMRS to show that the condition of a monument had changed since 1850, the condition was assumed to be

undamaged. The only exceptions to this rule were cases where monuments were first recorded as mutilated due to forestry, road building or other dateable events. If the dates of these events could be determined, then it was possible to assume that damage occurred at or around that time.

These assumptions ensured that all monument condition histories presented a best-case scenario, as no damage was assumed unless specifically described in the NMRS. It is inevitable that unrecorded damage will have occurred at many of the sample monuments, ensuring inaccuracies in the condition histories. Consequently, an accuracy assessment was undertaken for a sub-sample of monuments to quantify these inaccuracies. The results of this accuracy assessment were then used to calibrate the results of the desk-based study.

The causes of damage to monuments recorded through the desk-based study were noted where possible. In order to ensure effective analysis of these damage causes, it was necessary to categorise them into summary groups. These summary categories are shown in table 2.4, alongside a note of the most prominent constituent damage types recorded in each summary category. A comprehensive list of constituent damage categories used is presented in appendix C.

Damage Category	Principal types of damage agent included in category
Farming	Ploughing, drainage operations, removal / demolition to increase cropping area, vehicle damage, stock erosion.
Development	Housing, roads, pipelines, reservoir construction.
Mineral extraction	Large scale quarrying / mineral extraction, small scale quarrying carried out by farmers.
Forestry	Forestry ploughing, planting, vehicle damage, drainage.
Archaeological Excavation	Archaeological excavation (general), excavation in advance of development.
Building decay	Natural building decay
Building Renovation	Renovation for preservation, consolidation works.
Building Re-utilisation	Damage caused through re-utilisation, damage caused during renovation for re-utilisation.
Demolition	Demolition
Stone removal	Robbing of stone
Landscaping	Landscaping
Tree growth	Damage caused by tree growth / windthrow where the trees are semi-natural.
Vandalism	Vandalism
Unknown	Unknown, but where possible, a likely cause of damage was estimated.

Table 2.4. Summary of damage categories used in desk-based study.

Where damage to a monument was recorded in the NMRS but the cause of this damage could not be determined, aerial photographs and maps of various dates were consulted. Despite the use of aerial photographs and maps, many cases of damage were identified to which no cause could be attributed. In such cases, an estimate of probable damage cause was made, based on land use information and any further information about the monument contained in the NMRS record.

2.5.2 Information on archaeological characteristics of sample monuments

Information relating to the construction type of the monument was also determined using the NMRS. The following classes were used to categorise monument construction type:

1. Extant, predominantly earth built. This self-explanatory class applies to a wide range of monuments such as earthworks, barrows and turf-walled structures.

2. Extant, predominantly stone built. This class applies not only to the remains of standing buildings such as chapels and MOLRS, but also to standing stones, hut-circles and any other monuments where the primary construction material is stone.

3. Buried negative feature, such as cist or souterrain.

4. Cropmark, originally extant earthworks or extant stone structures. Initially, this category was split to distinguish between cropmarks representing earthwork and stone monuments. The distinction was quickly abandoned however, for reasons described in section 3.8.

5. Cropmark of invisible negative feature such as a souterrain.

Determining monument construction type from NMRS records was not always straightforward. In cases such as large earthworks or substantial stone structures, a classification can be determined rapidly. However, monuments such as shielings can be turf or stone built. Without a detailed description, it is not always possible to determine which the case may be. Unless stated otherwise, shielings were assumed to be of stone construction.

2.5.3 Land use

A number of methods were used to record land use. For current land use, a combination of LCS88, modern Ordnance Survey 1:10, 000 map sheets and written descriptions in the NMRS were used. For land use at 1850 and 1900, the Ordnance Survey 1st edition and 2nd edition maps were used. Land use was not recorded systematically for any other dates, but a note was made in any cases where damage to a monument was found to be associated with land use change. As the sample monuments were found to occupy a wide range of land cover types, it was necessary summarise the land use types into a number of categories. These summary land use classifications are shown in table 2.5, and a detailed list, including the LCS88 land cover classifications used to determine each of the land use categories, is presented in Appendix B.

Land Use Summary Classification	Land cover classes included
Arable / Improved	Arable and improved pasture*.
Non-arable improved	Parkland. Permanent improved pasture*.
Non-intensive land use	Unimproved pasture. Heather moor. Smooth grass / rushes. Bog / peatland.
Semi-natural woodland	Semi-natural woodland (coniferous, broadleaved, mixed). In clearing within any of the above. Plantation marked on OS 1st Edition maps.
Forestry	Plantation (young – mature). Recent ploughing. Recent felling. In clearing within any of the above.
Developed	Urban. Under road. Quarries / extraction. Under bings.
Semi-developed	Airfields. Golf courses. Caravan parks. Race courses. Cemeteries. Old mine workings
Enclosed	Enclosed. In yard or garden.
Verge / field margin	Within field boundary. Roadside verge. Miscellaneous linear features such as streams or shelter belts. Within Medieval or Later Rural Settlement (MoLRS) or uncultivated field margins.
Water	Loch. Reservoir.

Table 2.5. Summary land use classifications used in the research. A comprehensive list is presented in appendix B.

The two land cover classes marked with an asterisk (arable / improved and non-arable improved) require some explanation. At an early stage of the research it became apparent that using the 1:10,000 scale maps to determine and record land use would be very difficult among monuments in the enclosed agricultural landscape, as no distinction is made on the maps between arable and permanent pasture. Examination of the land use provided for each monument in these areas using the LCS88 provided indications of the likely land use, but the accuracy assessment included in the LCS88 final report (MLURI 1993) found that confusion rates between arable and improved pasture had been as high as 15% during aerial photograph interpretation. In any case, NCMS data for Tayside and Fife suggests that considerable interchange has occurred between arable and improved pasture in the study area over the last 50 years (Mackey *et al.* 1998, 182, 212), and temporary grassland ley is routinely included as part of the arable rotation. Therefore, in order to minimise the possibility of making erroneous distinctions between two land cover classes, both were included in the same category of 'arable / improved'. Only where it could be demonstrated from the written description in the NMRS that a monument was located in non-arable improved land was this land use classification applied.

It is worth noting here that by excluding nearly all monuments recorded in urban settings, the sampling strategy employed in this research has precluded the possibility of making an accurate assessment of monument loss in urban areas. Such remains have been excluded from this research as their extent can seldom be defined as a monument or finite entity, and most are recorded only during damage or destruction. Consequently, quantification of their loss would have be severely biased, adding little if anything to our understanding of how much of the urban archaeological resource has been damaged or lost. Such an assessment would be a major piece of research in its own right, and would be best undertaken using data from urban excavations and SMRs. Although some monuments in urban settings are included in this research, their number is limited to those whose extent (or perceived extent) can be defined, making recognition of their loss possible. In excluding a large component of urban archaeology, however, this research has enabled a detailed examination of changes in condition among monuments in the rural landscape.

2.5.4 Other environmental data

Variables such as local authority area and elevation were ascertained very rapidly using Arcview GIS to interrogate polygon themes (for local authority) and a digital terrain model (DTM) derived from the Ordnance Survey Land-form Profile™ data set, which provides contours at 5m intervals in addition to spot elevation data. The Land Classification for Agriculture maps for the study area were not available in digital form, and so this information was recorded manually using paper maps and acetate overlays.

2.5.5 Data collected for the accuracy assessment

As the data recorded for each of the monuments in the desk-based study were extracted from documents, photographs and maps and subject to some degree of interpretation, it was necessary to record further information for a smaller sample of the monuments included in the desk-based study to enable an assessment of the accuracy of the data retrieved. The two sets of data assessed in this way (for 258 monuments, a third of the sample) related to monument condition and land use. Both were assessed through collection of information from vertical aerial photographs, oblique aerial photographs, Historic Scotland Monument Warden reports, and through a programme of field survey.

Vertical aerial photographs were checked for the locations of all monuments for which the only written NMRS records pre-dated 1970 (68 monuments in total), in order to assess levels of change at the monuments since they were last recorded in the NMRS. Examining these vertical aerial photographs also enabled the recording of land use for comparison with the land use information retrieved through the desk-based study. Vertical aerial photographs were also examined for all monuments in the desk-based study at which no date or cause could be ascribed to recorded damage. Oblique aerial photographs were checked for all cropmark monuments recorded over a period of more than 10 years (79 monuments in total). Examining photographs showing monuments over a long time-span enabled an assessment of levels of non-agricultural damage occurring to cropmark monuments but not noted in the NMRS. In the examination of vertical and oblique aerial photographs, the summary monument condition, damage causes and land use categories used were the same as those used in the desk-based study.

All Monument Warden reports available for scheduled monuments in the sample were examined (58 in total, although reports were not available for all scheduled monuments). These contain detailed information on recent monument condition, causes of damage to monuments, and land use. Although these reports were available only for scheduled monuments, they were found to provide extensive information not available through the desk-based study. The final method by which accuracy of data obtained in the desk-based study was assessed was through a programme of field survey. A total of 71 monuments were selected for surveying, although only 61 were surveyed due to time and access constraints imposed by the foot and mouth outbreak of 2001. The sample of monuments surveyed was determined in a similar manner to that of the desk-based study. All surviving extent monuments within the desk-based study sample were grouped according to land use, and counted. It was ensured that the monuments selected for survey were representative of the overall land use figures for surviving extant monuments, as demonstrated in table 2.6.

Land Cover Category	Percentage of surviving extant sample monuments	Percentage of field survey sample monuments	Number of field survey sample monuments
Arable / improved	36.3	32.4	23
Forestry	7.9	9.9	7
Semi-natural woodland	7.7	8.5	6
Non-intensive land use	44.9	45.1	32
Urban	2.6	2.8	2
Water	0.7	1.4	1
TOTAL	100	100	71

Table 2.6. Numbers of monuments included in the sample for survey during the accuracy assessment, according to land use.

The field survey sampling was undertaken at an early stage of the desk-based study, at which time the land use for sample monuments had only been determined using the LCS88. Unfortunately, it later transpired that using the LCS88 had causing significant inaccuracies in the recording of land use, because most areal units in the LCS88 are mapped at minimum units of 10ha. Only woodland (2ha minimum mapping unit) and built areas (5ha minimum mapping unit) are mapped at higher resolution. Because of this, small parcels of land such as enclosures, field margins and verges were not recognised at this early stage, and the land uses recorded though the LCS88 at many of the monuments selected for field survey were found to be inaccurate. This problem was compounded by inaccuracies in the grid coordinates provided for each sample monument from the NMRS data download. Many of these were based upon 6 figure grid references (not all of which were accurate themselves), placing some grid coordinates in the GIS up to 150m away from the actual monument locations. Inevitably, in the case of some larger monuments, the grid coordinates were entirely insufficient in identifying the monument locations accurately, due to the significant spatial extents of the monuments involved. Although these inaccuracies were found throughout the sample of monuments visited, their significance was greatest where monuments were situated in small units of land. Unfortunately, nearly all of these were in lowland arable areas. When the sample of monuments to visit was generated, the LCS88 land use information suggested that 23 would be located in arable or improved land (table 2.6). Time constraints ensured that only 19 of these monuments were visited, but of these 19, only one was found to be situated in arable with a further six located in permanent or rotational pasture. The remainder were located enclosures (six monuments) and verges or field margins (six monuments).

At each of the monuments visited, careful note was made of any damage not recorded through the desk-based study. Initially, it was intended that precise measurements would be made at every monument and details on the exact nature of damage indicators would be recorded. The reasons for this were twofold. First, it was planned to produce a detailed study of the condition of this sub-sample of monuments, quantifying not only past damage but also ongoing management issues including scrub and bracken growth, stock erosion, tree growth and burrowing animals. Secondly, the data collected was to have formed a baseline dataset against which future condition could be assessed. In the event, however, time and access constraints caused by the Foot and Mouth outbreak of 2001 meant that although some of the early surveys (in November and December 2001) were very detailed, as the programme of survey advanced it became necessary to reduce the amount of time devoted to each monument. Consequently, although the information retrieved through the programme of field survey has been more than sufficient to assess the accuracy of the desk-based study, it has not been possible to undertake a detailed analysis of ongoing management issues at these monuments. It is possible that the photographic record made during the field survey could be used as baseline condition data in the future, but the majority of the written material produced by these surveys would be inadequate for such a purpose. A copy of the pro-forma recording sheet used during the field survey is included in Appendix D.

2.5.6 Analysis of data

The methods used to analyse the data collected through the desk-based study and accuracy assessment are described fully throughout chapters 3, 4 and 5. However, it is worth mentioning briefly the types of analysis employed and the reasons for their employment. As outlined in section 2.3.1, no hypotheses have been tested in this research. Instead, analysis has concentrated on the identification of general trends in the data collected. Essentially, all analysis of data retrieved through the desk-based study has been descriptive, identifying general relationships between variables. As chapters 3, 4 and 5 demonstrate, these general relationships have been presented by use of maps, frequency distributions, charts and cross-tabulations.

It is worth reiterating here that the desk-based study and accuracy assessment have retrieved little meaningful data relating to condition changes and management issues relating to cropmark monuments. Consequently, it has been necessary to employ a different approach to include cropmark archaeology in the research, based on limited excavations and basic modelling techniques using GIS. The methods used and results produced are described in chapter 6.

Chapter 3

3. A census of archaeological monuments in the study area

This census characterises the distribution of field monuments within the study area and assesses their distribution in relation to a number of variables such as monument period and material construction, land use, Land Capability for Agriculture and altitude. A number of relationships have been identified between monument distribution and these variables, many of which illustrate the impacts of non-archaeological variables such as patterns in survival and recording on perceived distribution of monuments.

Although change in monument condition since 1850 is discussed in chapter 4, this census has made no assessment of monument condition except to distinguish between cropmark and non-cropmark monuments as a means of loosely determining monument survival and condition. Knowledge of the archaeological record within this study area has changed rapidly in the last 30 years as a result of the recording of cropmark sites. Failure to make the distinction between cropmark and extant monuments would over-simplify analysis to such an extent that some relationships might not be identified, particularly those involving land use. In addition to examining monument distribution in relation to environmental factors, the census has sought to identify biases in detection and recording which may have distorted perceived monument distribution patterns. Consequently, all 779 sample monuments have been included in this census irrespective of their current status, despite the fact that some 46 of the 779 have been destroyed since 1850. To exclude destroyed monuments from this analysis would mean that the numbers of monuments recorded in urban and arable areas would be under-represented, as most buried monuments such as cists have been recorded only during their destruction.

3.1 The nature of the National Monuments Record of Scotland

As all information on the nature of the monuments in the desk-based study has been taken from the NMRS, it is important to recognise the variations in the quality of information contained within each of the NMRS records. To achieve this, the desk-based study has recorded numbers of dated records for each of the sample monuments and the dates of the first and last dated NMRS descriptions of each sample monument. Examination of these sets of information helps to illustrate the nature of the information taken from the NMRS on which this research is based, and highlights areas within the NMRS where information is relatively scarce. It also helps to illustrate trends in archaeological interest since 1850, and the history of archaeological recording within the study area.

3.1.1 Variations in written detail among sample monuments

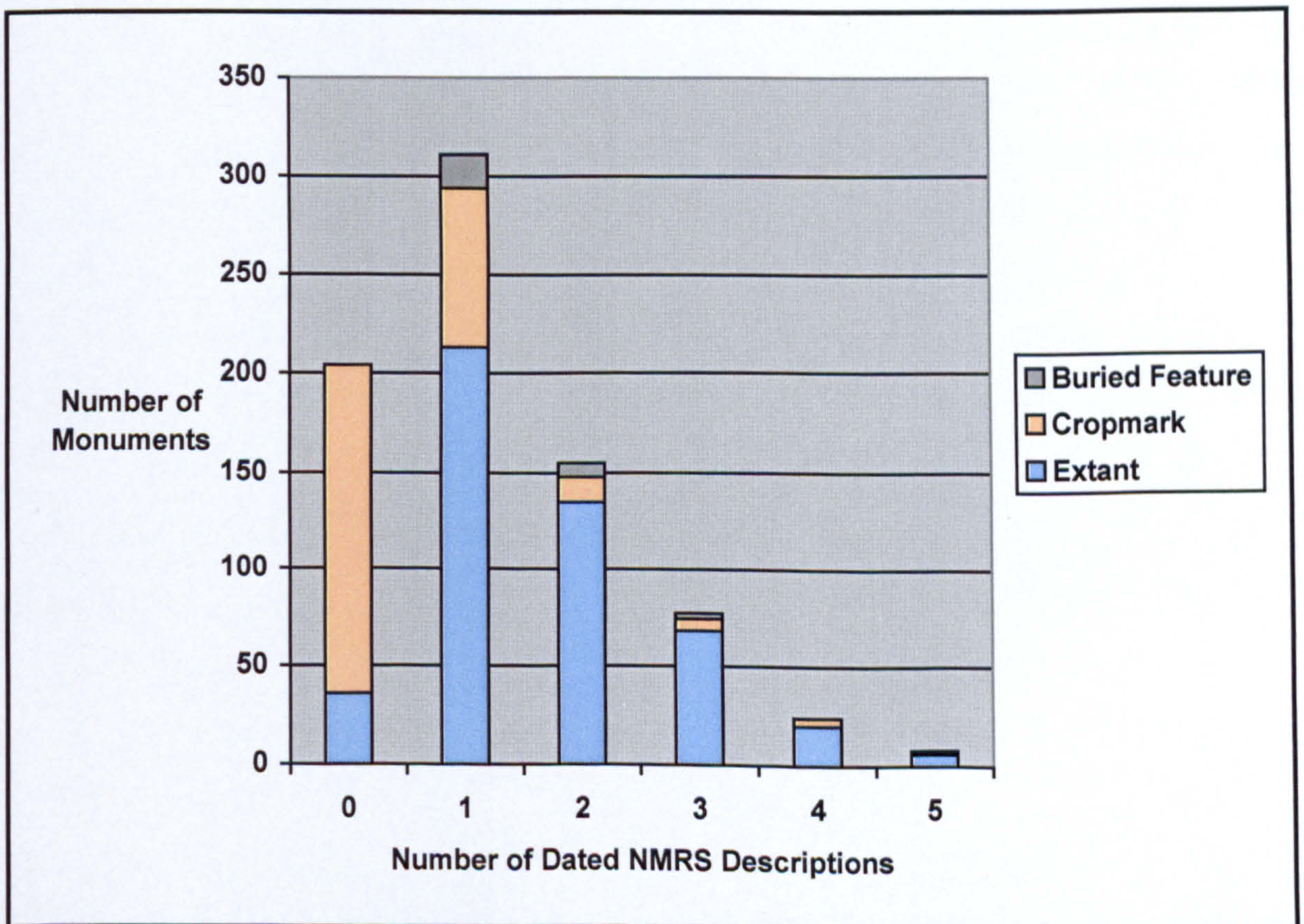

Figure 3.1. Numbers of dated NMRS descriptions for buried, cropmark and extant sample monuments.

Figure 3.1 shows numbers of dated records for each of the monuments examined in the desk-based study. As figure 3.1 demonstrates, only 24 of the 273 cropmark monuments in the sample have more than one dated NMRS description. A further 81 have a single dated description, but the majority (168) of cropmark monuments have no description in the NMRS. A greater level of information is held within the NMRS for extant monuments, with only 36 extant monuments in the sample having no dated NMRS description. All but three of these are of post-medieval or unknown date and it likely that they have been identified from aerial photographs. A further 213 extant monuments have a single dated description, with the remaining 229 having two or more dated NMRS descriptions. Among the 28 buried features included in the sample, 17 have only one dated NMRS description and seven have two dated NMRS descriptions, leaving only four with three or more dated NMRS descriptions.

Examination of the numbers of dated entries per monument within the NMRS helps to illustrate types of monuments for which the NMRS contains relatively little information, such as cropmarks or extant monument identified using aerial survey. In some cases, monuments can be identified which have been excavated on a number of occasions, or have been damaged on a number of occasions, leading to a large number of dated descriptions being included in the NMRS. By examining the numbers of dated NMRS entries per monument in this manner, it is also possible to illustrate which types of monuments have received greatest interest within the last 150 years. For example, of the 191 extant prehistoric monuments in the sample, 58% have two or more dated descriptions in the NMRS. Of the 29 extant demonstrably medieval monuments (see section 2.5.2 for definition of monuments in this group), 72% have two or more dated descriptions. By contrast, of the 207 extant medieval or post-medieval monuments in the sample, only about 40% have 2 or more dated descriptions, and for extant monuments of unknown date, this figure drops to about 20%. This demonstrates that despite the recent increase of interest in post-medieval archaeology in Scotland (e.g. Hingley 1993; Govan 2003), prehistoric and medieval monuments have held considerably more archaeological interest than those of post-medieval date over the past 150 years.

3.1.2 Sample monuments and the dates of their record

Examination of numbers of dated records in the NMRS for various monument types illustrates some of the characteristics of the information on which the desk-based study is based. Trends in archaeological interest since 1850 and the nature of the information contained within the NMRS can be further illustrated through examining the dates at which each of the monuments in the desk-based study is first recorded. Many of the sample monuments are first recorded long before 1850, usually in the Statistical Accounts of the late 18th century (approximately 25 monuments) and New Statistical Accounts (approximately 21 monuments) of the 1830s and 1840s. As one of the main functions of the desk-based study is to trace monument condition change since 1850, no records pre-dating 1850 have been noted for analysis.

Further to this, it should be noted that within the NMRS text reports, many of the early sources are named alongside later sources, but the written descriptions of the monuments in question are ambiguous as to which of the sources the written archaeological information is taken from. Consequently, although a number of monuments have clearly been recorded by antiquarians or are referred to in the Ordnance Survey Name Books (dating from about 1854 to 1865), many of these sources have not been described explicitly by date in the NMRS. In such cases, the desk-based study has recorded as the first date of record the first source in the NMRS entry which is of identifiable date. It should be emphasised also that even where no antiquarian accounts of monuments exist within the NMRS, the first written descriptions do not necessarily represent the date of discovery.

The caveats described notwithstanding, dates of first record after 1850 within the NMRS do help to illustrate trends in archaeological interest and survey over the last 150 years.

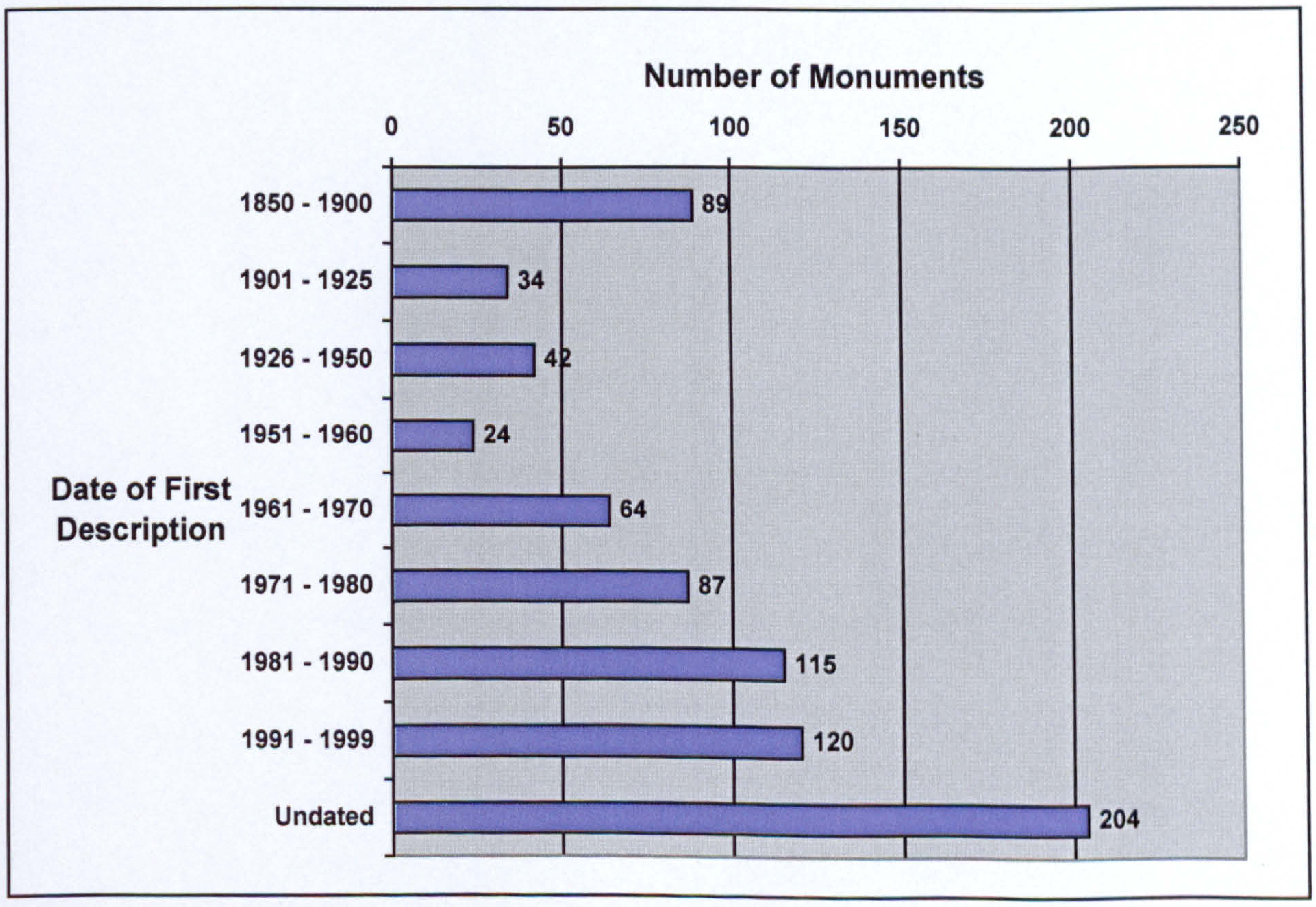

Figure 3.2. Dates of first dated NMRS descriptions among sample monuments.

Figure 3.2, which shows the dates of the first records for each of the monuments within the desk-based study, demonstrates a steady increase in numbers of monuments recorded in the second half of the 20th century, though a significant number have no dated

NMRS description at all. Of the 89 monuments recorded between 1850 and 1900, about a quarter are farmsteads or other post-medieval structures shown on Ordnance Survey 1st Edition maps, but which do not have dated written records from the time of the Ordnance Survey 1st Edition mapping. As these monuments have been recorded retrospectively, they do not reflect a trend in archaeological recording in the latter part of the 19th century. The majority of the other monuments in this group (all of which *were* recorded between 1850 and 1900) are stone-built monuments such as churches, tower-houses and stone circles, which were recorded by antiquarians such as Andrew Jervise (c. 1860), Alexander Warden (1880-85), and MacGibbon and Ross (c. 1887-92). The bias towards 'status' monuments in recording continues until 1925, with all but eight of the 34 monuments recorded between 1901 and 1925 being of stone construction and of prehistoric or medieval date. It is notable also that only two monuments are recorded between 1914 and 1919. This exemplifies further the complexity of the data on which the desk-based study is based as it demonstrates the influence of external factors (in this case, The First World War) on archaeological recording within the study area.

Further examples of the influences of external factors on archaeological recording are demonstrated in the types of monuments recorded between 1926 and 1950. During this period, although the majority of monuments recorded are prehistoric or 'status' sites such as tower-houses and churches, six of the 42 monuments recorded between 1926 and 1950 are dovecots, all of which are located in Fife. It is likely that these records reflect a systematic survey of dovecots undertaken for the publication of the Fife Monuments Inventory in 1933. Between 1951 and 1960, of the 24 monuments recorded, six are cists. This flurry of cist discoveries in agricultural land during the years following Second World War has been documented elsewhere (RCAHMS 1994, 11), and is thought to have been due at least in part to the development of larger agricultural machinery. Six cropmark monuments in the sample are noted for the first time in the 1950s. Of these six, four are Roman Temporary Camps noted and recorded by J K S St Joseph.

By examining dates of first record of monuments in relation to altitude, the influence of external factors on archaeological recording can again be identified in the decades since 1950. Until 1960, only about 20% of recorded monuments were situated above 200m OD. However, the proportion of monuments recorded above 200m OD increased to 40% during the 1960s, peaking at 70% in the 1970s, and dropping to 60% in the 1980s as the numbers of cropmark monuments recorded through systematic aerial survey by the RCAHMS continued to increase. This dramatic increase in recorded monuments in upland areas during the 1960s, 70s and 80s was due primarily to an increased interest in upland archaeology, partly in response to the threat posed by large-scale forestry planting in the years following the Second World War (Dunbar 1989, 13). For example, at least ten of the sample monuments found in upland Perthshire were first noted by M E C Stewart in the 1960s, who was active in rescue excavation and acted for many years as an unofficial 'county archaeologist' (RCAHMS 1994, 6), while 28 of the 53 sample monuments incorporating hut-circles were first recorded in the 1970s by the Archaeological Division of the Ordnance Survey. In the 1980s, the bulk of the upland monuments were recorded through RCAHMS field survey.

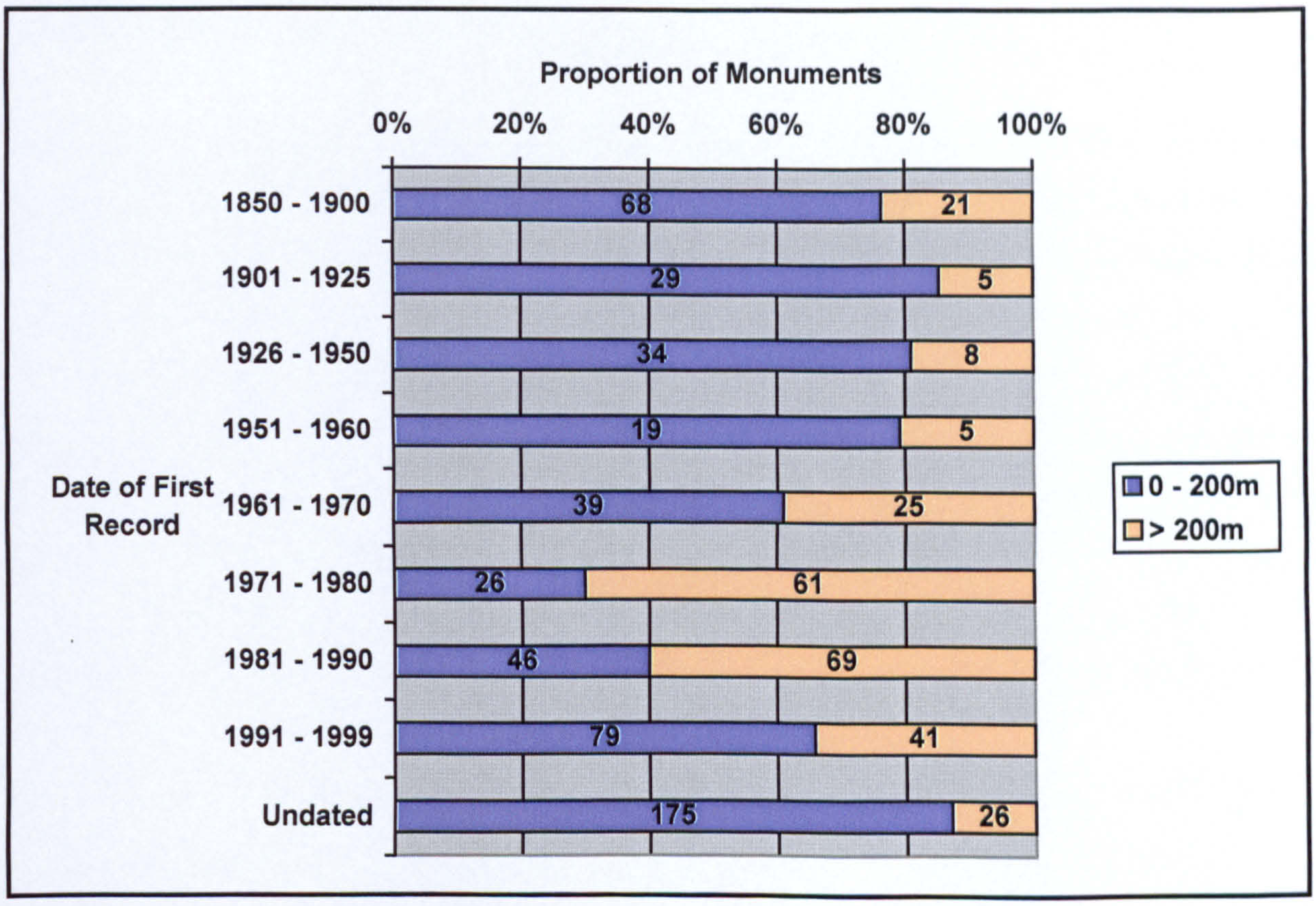

Figure 3.3. Dates of first dated NMRS descriptions among sample monuments according to elevation.

Figure 3.3 shows numbers of sample monuments by the dates they are first recorded within two elevation categories: those situated above 200m OD and those situated below 200m OD. It illustrates the increase noted in the recording of upland monuments in the 1960s, 70s and 80s. Due to this increase in the recording of upland monuments, many monument types are recorded from 1960 onwards for which few, if any, records of an earlier date exist. For example, eight sets of cup-markings and four 'Glen Lyon' type homesteads (monuments characteristic of parts of highland Perthshire) are first recorded in the 1960s. The preponderance of archaeological recording in upland areas is even more pronounced through the 1970s, when of 87 monuments recorded, only four are cropmarks. Of the remaining 83 monuments, over a third are hut-circles (many with associated field systems), and a further five are groups of cup-markings.

Moving into the 1980s, the increase in upland field survey by the RCAHMS can be identified through the large numbers of MoLRS noted for the first time, including 18 monuments classed as 'building' and a further 16 monuments associated with medieval or later agricultural settlement, such as farmsteads, sheilings and rig. Upland survey during the 1980s is further attested to by the recording of 11 hut-circles and five burnt mounds, a monument type not recorded in the sample before 1980. Thirty-one of the sample monuments first noted in the 1980s are cropmarks.

The trend in recording upland monuments established through the 1970s and 80s was reversed in the 1990s, when recorded monuments below 200m OD outnumbered those above 200m OD by two to one. Of the 69 extant sites first recorded in the 1990s, 20 are prehistoric, while nearly 40 are medieval or post-medieval in date. Of the 51 cropmarks monuments noted in the NMRS in the 1990s, 40 are prehistoric, with the remaining eleven of unknown date. A significant proportion (26%) of sample monuments have no dated descriptions within the NMRS. Of the 36 extant monuments with no dated entries, all but three are low-status monuments of medieval or later date, or of unknown date. Most have been recorded through aerial survey, as 168 are cropmark monuments. It is likely, therefore, that most of these will have been recorded for the first time in the last 20 years.

The variations noted in levels of information between monument groups in the NMRS serve to illustrate that the data on which the desk-based study is based is likely to be subject to a large number of biases and inconsistencies. Efforts have been made to minimise the effects of these biases on analysis (chapters 4 and 5), but it should be remembered that although standardisation and rationalisation of data has been attempted wherever possible, the data on which the desk-based study has been based is the product of 150 years' interest in archaeology by countless hundreds of individuals. Some of this data has been assembled in a non-systematic manner, and its quality has been influenced by external factors.

3.2 Monument distribution and local authority area

The majority of the monuments in the sample are situated in low-lying areas, where the land use is predominantly agricultural. As figure 3.4 demonstrates, there are particular concentrations of monuments recorded in Strathearn (A) and lower Strathtay (B), as well as a high concentration of cropmark monuments in NE Fife (C). Upland areas that have been subject to intensive survey are well illustrated by the density of sample monuments on the Lomond Hills in Fife (D), and the concentration of monuments in upland NE Perthshire, particularly in Strathardle (E).

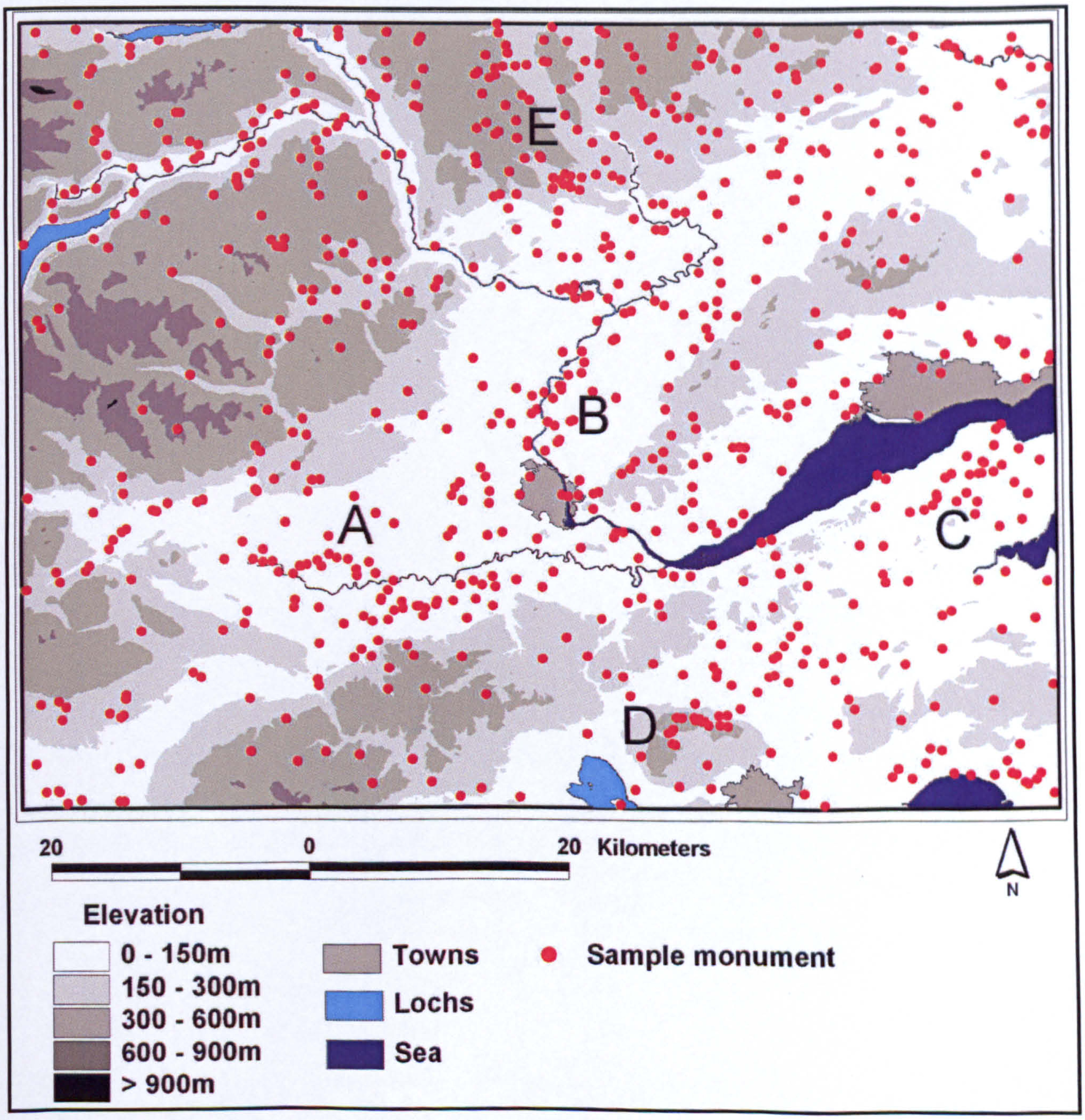

Figure 3.4. Map showing sample monument distribution.

Most of the monuments in the sample are in Perth and Kinross, which contains some 67% of the sample (521 monuments). Fife (134 monuments, 17%) accounts for the second largest monument group according to local authority area, while Angus contains 98 (13%) of the monuments in the sample. Dundee, Stirling and Clackmannan contain 8, 17 and 1 sample monuments respectively. Although these figures suggest biases in the sample according to local authority area, numbers of monuments according to local authority area are broadly indicative of the geographical extent of each of the local authorities within the study area.

Local Authority Area	Area of land within study area (sq km)	Percentage of land within study area	Number of sample monuments	Percentage of sample monuments	Number of sample monuments per 100 sq km
Perth and Kinross	3112	66.5	521	66.9	16.7
Fife	710	15.2	134	17.2	18.9
Angus	635	13.6	98	12.6	15.4
Stirling	131	2.8	17	2.2	12.9
Dundee	53	1.1	8	1.0	15.2
Clackmannan	38	0.8	1	0.1	2.7
Study Area	**4679**	**100**	**779**	**100**	**16.6**

Table 3.1. Areas of local authorities and numbers of sample monuments.

Table 3.1 shows that the highest density of sample monuments occurs within Fife, where the majority of land is low-lying (exactly half of the sample monuments in Fife are cropmarks), and thus favourable for the identification of monuments. By contrast, the majority of study area land within Stirling and Clackmannan is located at altitude, and so it is perhaps little surprise that there is a lesser density of sample monuments within these local authority areas.

3.3 Monument distribution and period

Of the 779 monuments in the sample, nearly half (381, 49%) are of prehistoric date. Around 27% (210) are of post-medieval date, while monuments of unknown date account for some 17% (136) of the sample. The remaining 7% of the monuments in the sample are of Roman (21) or Medieval (31) date. Figure 3.5 shows the locations of each of the prehistoric monuments in the sample. Included in this group of 381 prehistoric monuments are four monuments dating to the later Iron Age or Pictish period. These are an excavated cropmark enclosure $^{c}14$ dated to the 6^{th} – 7^{th} century, two cropmark square barrows, and a Pictish cross-slab. Prehistoric monuments are found throughout the study area, though concentrations can be noted in Upper Strathtay, NE Fife, and NE Perthshire.

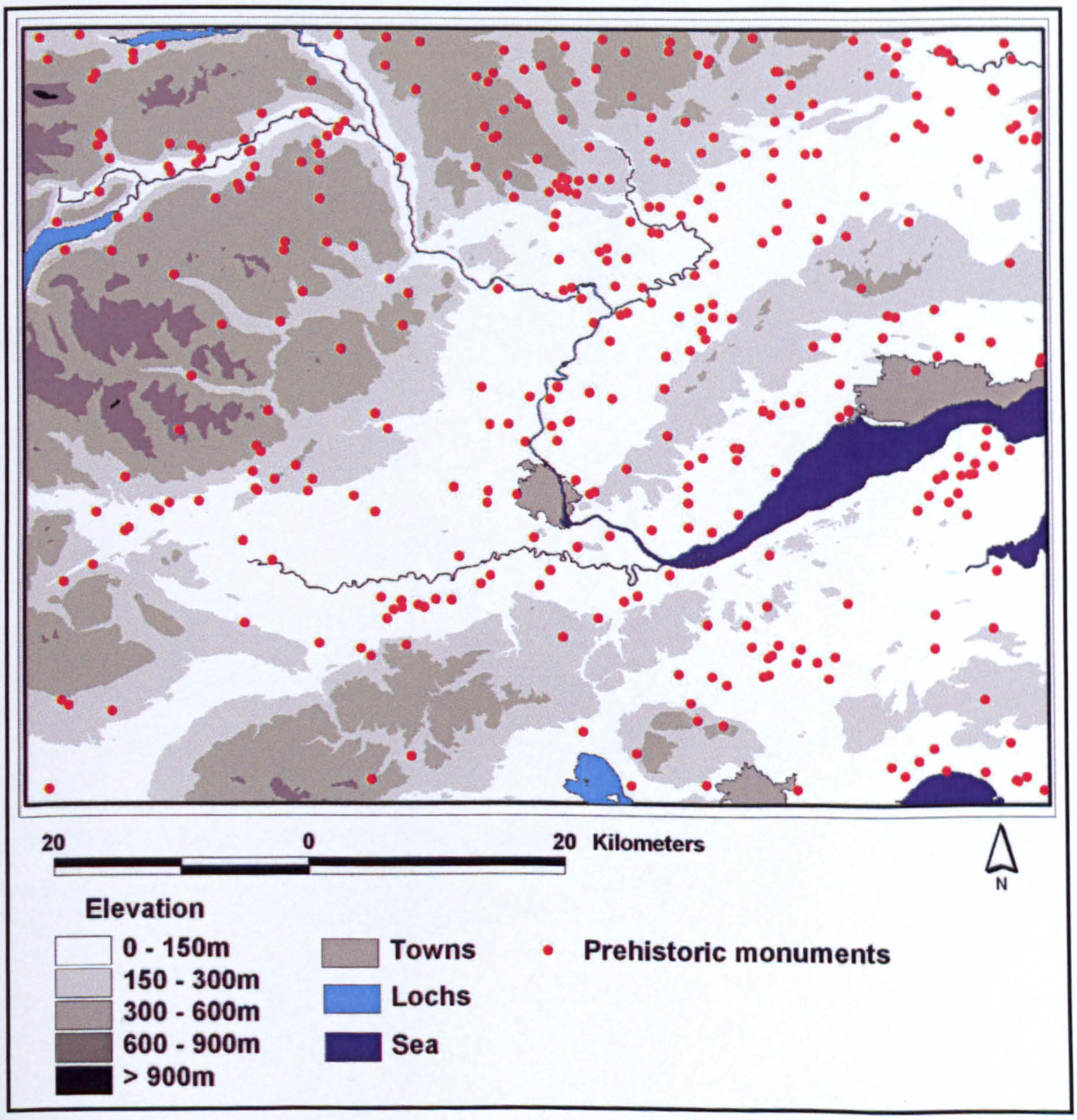

Figure 3.5. Map showing distribution of prehistoric sample monuments.

As demonstrated in figure 3.6, most of the prehistoric monuments in the sample are situated at low altitudes, with 253 lying beneath 200m OD. Figure 3.6 also demonstrates a sharp drop in numbers of prehistoric monuments with altitude. That so many are situated at low altitude is partly indicative of the large proportion of cropmarks making up the overall sample.

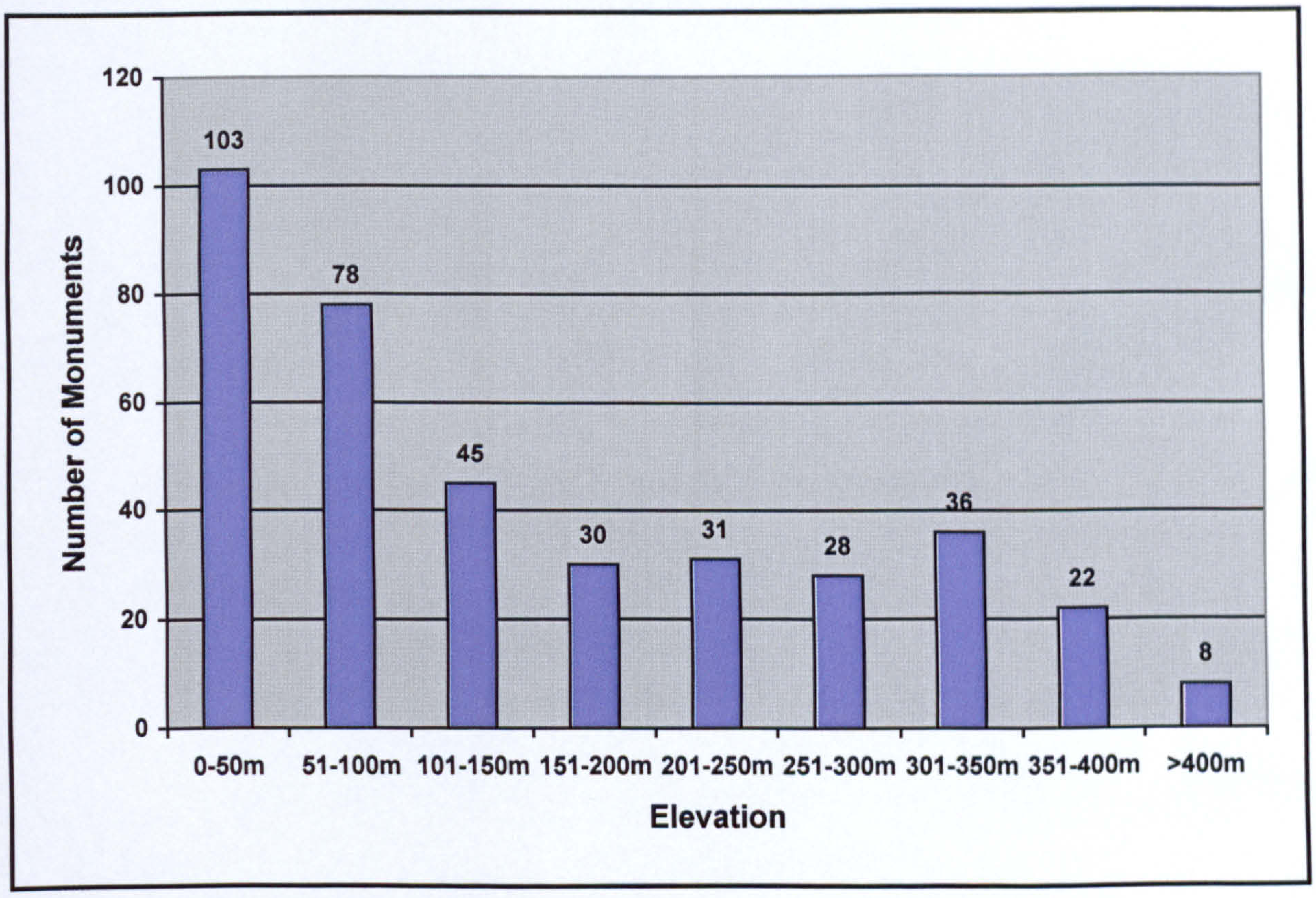

Figure 3.6. Numbers of prehistoric monuments according to elevation.

Although there are only 21 monuments of Roman date in the sample, these demonstrate a clear archaeological distribution (figure 3.7). All but three of the Roman monuments in the sample are situated along a line from Dunblane in the SW to Forfar in the NE. Essentially, these monuments plot the course of the Agricolan campaigns of the late 70s AD, and consist of forts, temporary camps and sections of Roman road. Two of the watch-towers of the Gask Ridge are included in the sample. The Roman monuments in the sample are located almost exclusively at low altitude, with only two situated above 150m OD.

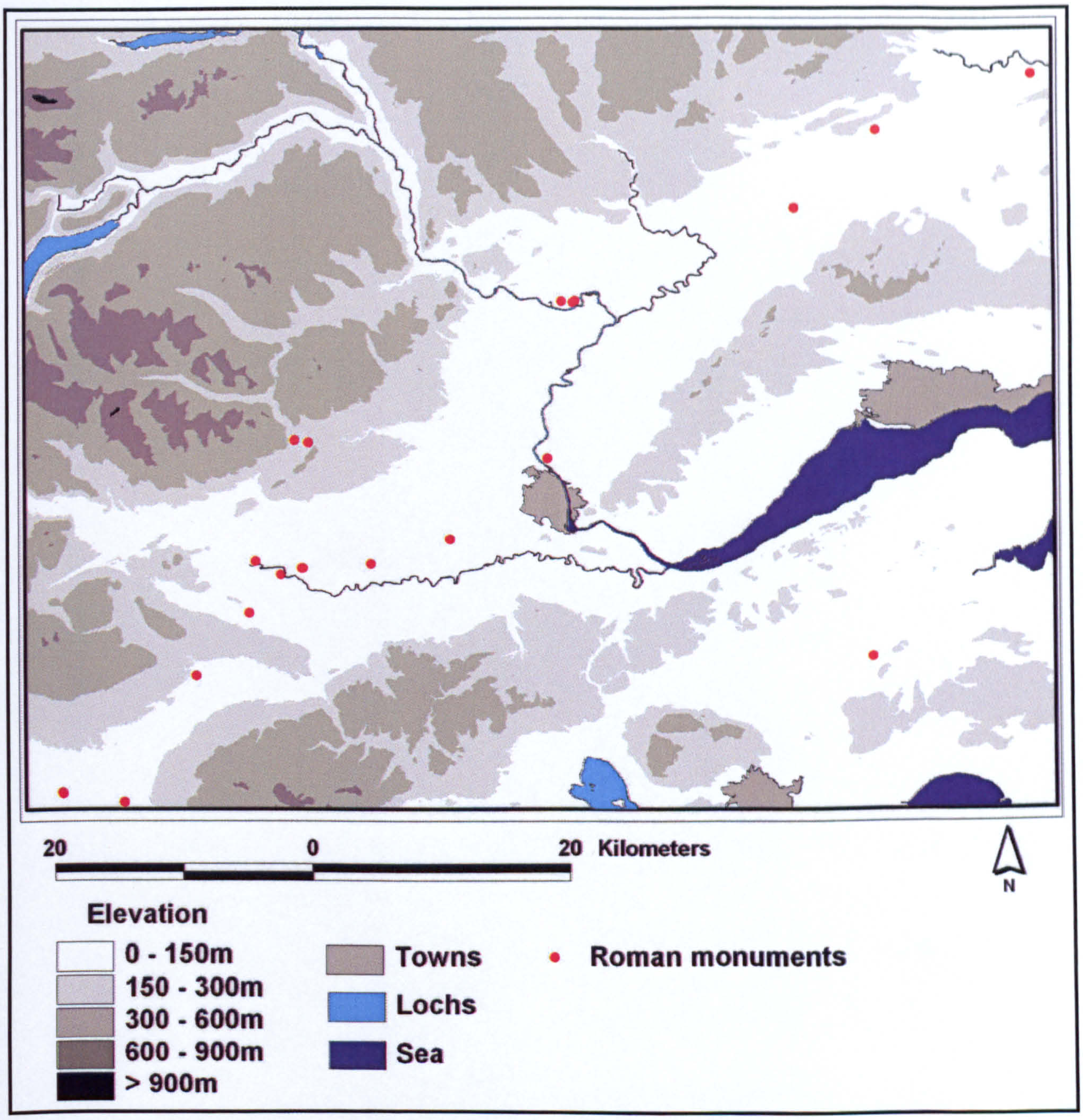

Figure 3.7. Map showing distribution of Roman sample monuments.

Monuments demonstrably of medieval date are distributed sparsely throughout the study area. This group of 31 monuments includes mottes, chapels and castles, along with three Pitcarmick-type buildings. With the exception of the Pitcarmick-type buildings, all are situated at an altitude of less than 200m OD. By contrast, the distribution of monuments which cannot be ascribed a medieval date with certainty but are of likely medieval or later date includes a number of monuments situated in more marginal upland locations, as shown in figure 3.8.

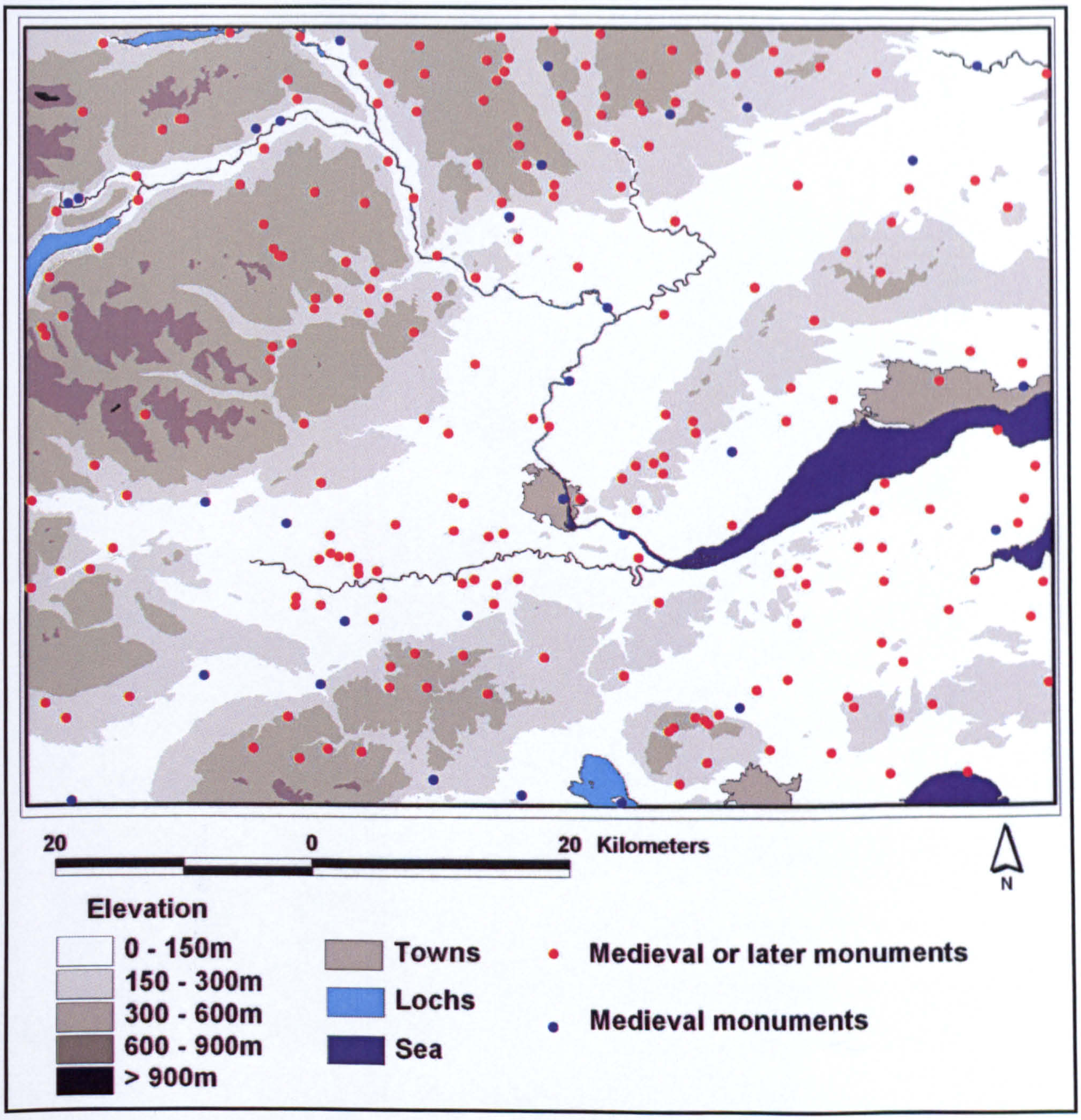

Figure 3.8. Map showing distribution of medieval and post-medieval sample monuments.

As outlined in section 2.5.2, where no written report is included in a monument's NMRS record and a monument's classification is ambiguous (such as 'enclosure', which gives no indication of period), monuments are treated as being of unknown date. Consequently, a high proportion of the cropmark monuments in the sample are ascribed no period. Other monuments classed as 'unknown' date include buildings that are probably post-medieval but which have no written record in the NMRS. The distribution of sample monuments for which no period has been ascribed is shown in figure 3.9.

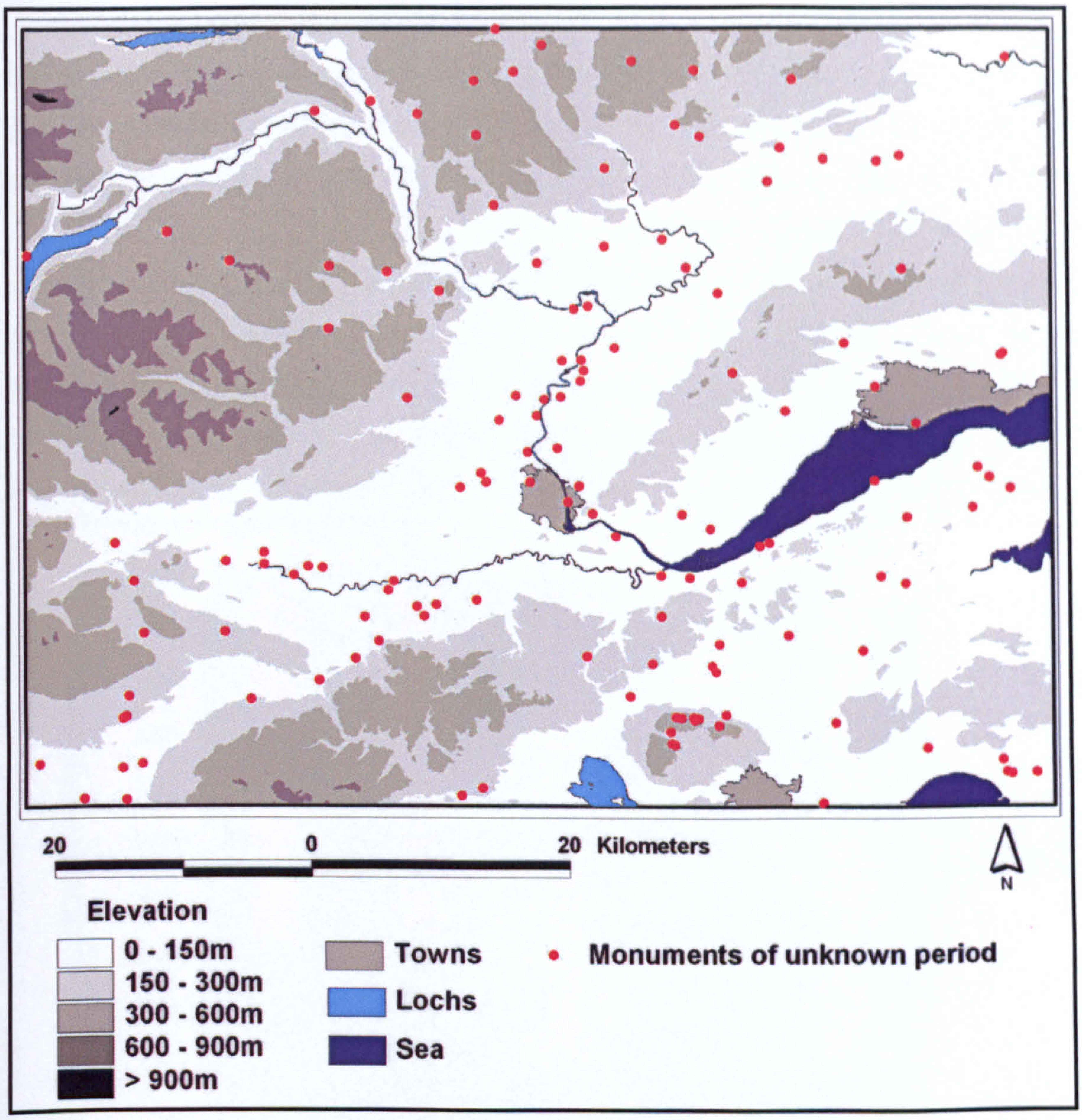

Figure 3.9. Map showing distribution of sample monuments of unknown period.

In summary, distribution of monuments within the study area varies according to their period of construction and use. Prehistoric monuments are found throughout the study area, while Roman monuments are concentrated along the line of the Agricolan campaign of the late 1st century AD and the Gask Ridge. Demonstrably medieval monuments, most of which are high-status sites, are concentrated at low altitudes, while many of the MoLRS that make up the bulk of the medieval or later monuments in the sample are found at higher altitudes. While it is unquestionable that some of these variations in distribution have genuine archaeological meaning, it is inevitable that the distribution patterns will also reflect biases in monument survival and detection.

3.4 Statutory protection among sample monuments

In September 2002, all scheduled ancient monuments in the study area were noted to enable a review of scheduled ancient monuments within the desk-based study. By examining the types of monuments scheduled and the dates at which they were scheduled, it is possible to identify changing priorities in scheduling practice since 1920, often in response to the new identification of certain monument types. It should be noted that six of the scheduled sample monuments are also Properties in Care of the Scottish Ministers (PiCs), and that 21 of the 31 pre-Second World War schedulings have been revised in recent years to ensure that they afford the monuments adequate protection. In September 2002, 171 of the 779 monuments (22%) in the sample were scheduled.

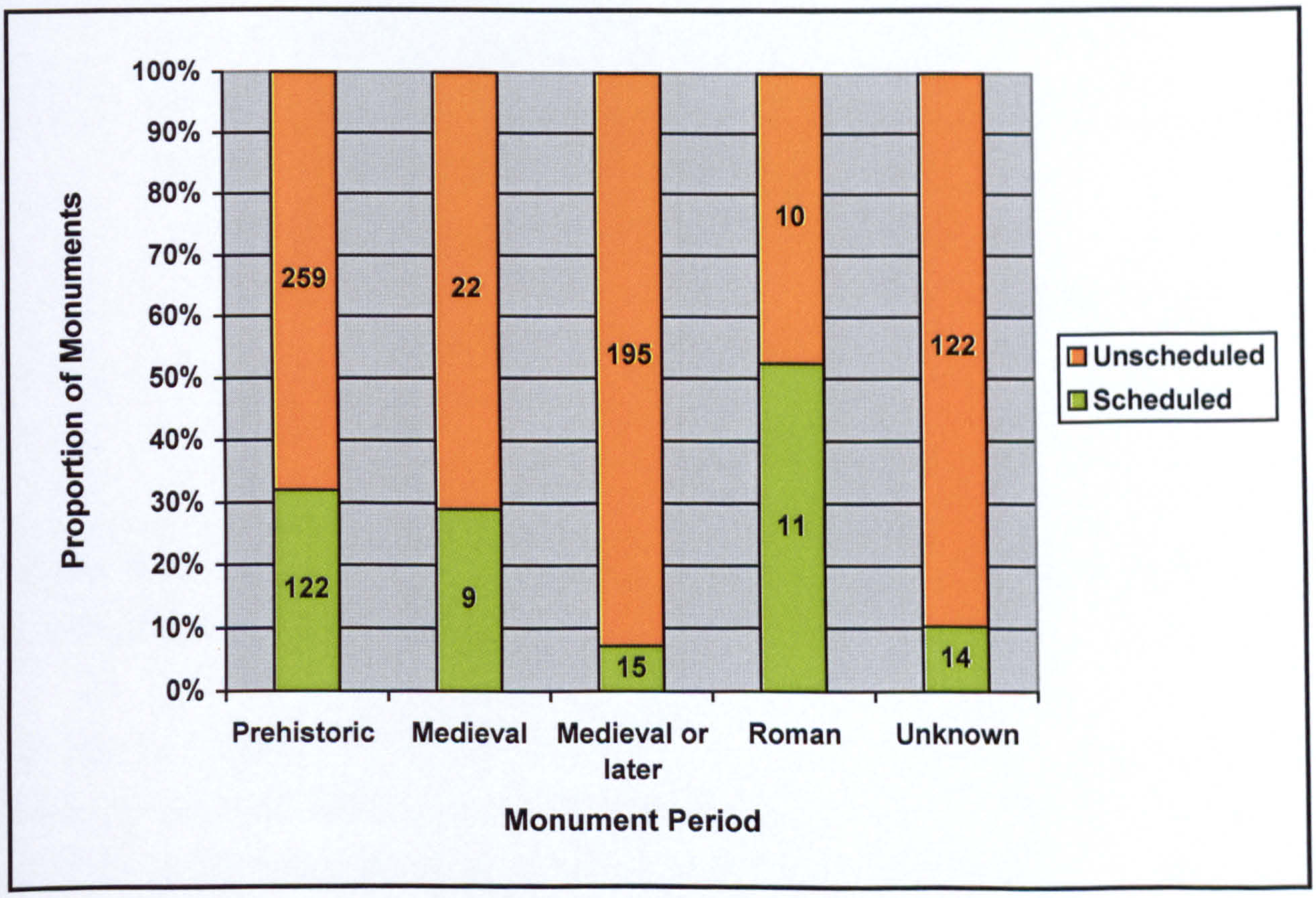

Figure 3.10. Numbers and proportions of scheduled and unscheduled sample monuments according to monument period.

Figure 3.10 shows numbers and percentages of monuments scheduled according to period, and demonstrates that of the 171 scheduled monuments in the sample, 122 are prehistoric, nine are medieval, 15 are medieval or later, 14 are of unknown period and 11 are Roman. More interesting is that 32% of prehistoric monuments and 29% of medieval monuments are scheduled, whereas only 10% of unknown period monuments and 7% of medieval or later monuments are scheduled. The Roman monuments in the sample are the best protected, with over half being scheduled, though it should be remembered that there are only 21 Roman monuments in the sample. These figures reflect the use of a number of criteria in determining the importance (national or otherwise) of monuments, with Roman, prehistoric and 'status' medieval monuments traditionally being ascribed greater importance than those of medieval or later date and unknown date.

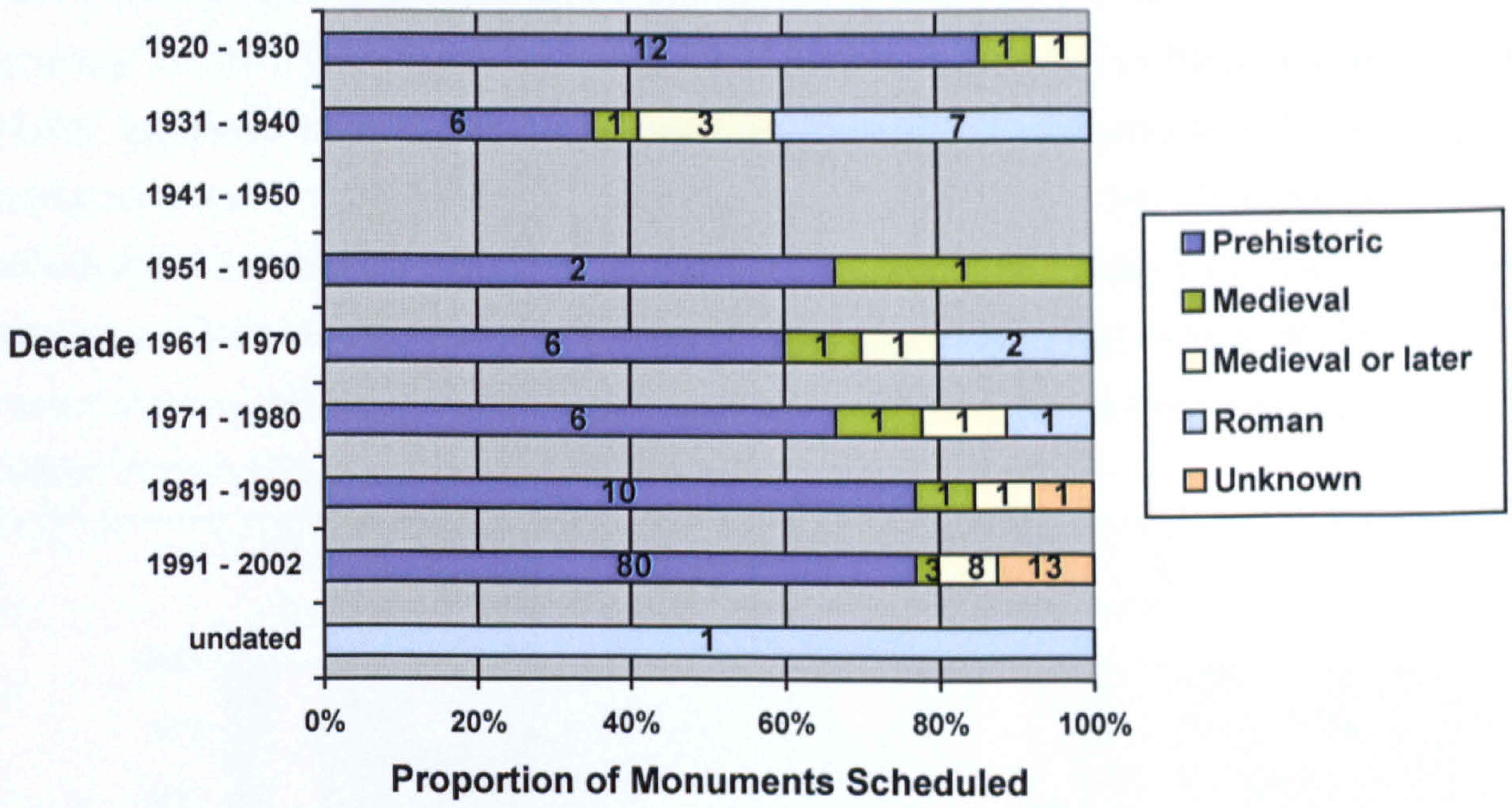

Figure 3.11. Proportions and numbers of sample monuments scheduled by decade, according to monument period.

As figure 3.11 demonstrates, the majority of scheduling within the study area has taken place in the last 15 years, but the emphasis on the scheduling of prehistoric, Roman and Medieval monuments has remained largely unchanged since the 1920s. In each decade, the majority of monuments scheduled are prehistoric, with the exception of the 1930s, when there was a spate of scheduling of Roman sites. In recent decades, cropmark monuments of unknown date have been scheduled in increasing numbers. The period classification 'unknown' is applied to all monuments of an ambiguous classification (such as 'enclosure') for which no description exists within the NMRS. Consequently, many cropmark monuments are classed as 'unknown period' in the desk-based study, and although figure 3.11 suggests that a significant proportion of recent schedulings are of monuments of unknown date, in reality, nearly all of these are cropmark enclosures, which are likely to be of prehistoric date.

Despite the continued emphasis observed in the scheduling of prehistoric monuments, examination of the types of monuments scheduled at different dates shows that the types of monuments scheduled have varied significantly, particularly over the last 40 years. Up until 1960, the majority of monuments scheduled were status monuments situated in lowland areas, such as stone circles, barrows, tower-houses and Roman sites. In the 1960s, monuments scheduled again comprised a mixture of prehistoric defensive and funerary, Roman, and medieval sites located almost exclusively in lowland areas. In the 1970s, the established pattern began to change, with the increased scheduling of upland monument types. This trend continued into the 1980s, when of the 13 sample monuments scheduled, 12 were located above 250m OD, including hut-circles, field systems and cup-markings. This probably reflects the increased recognition of the need to protect monuments in upland settings, in response to the large-scale forestry planting of the 1960s, 70s and 80s.

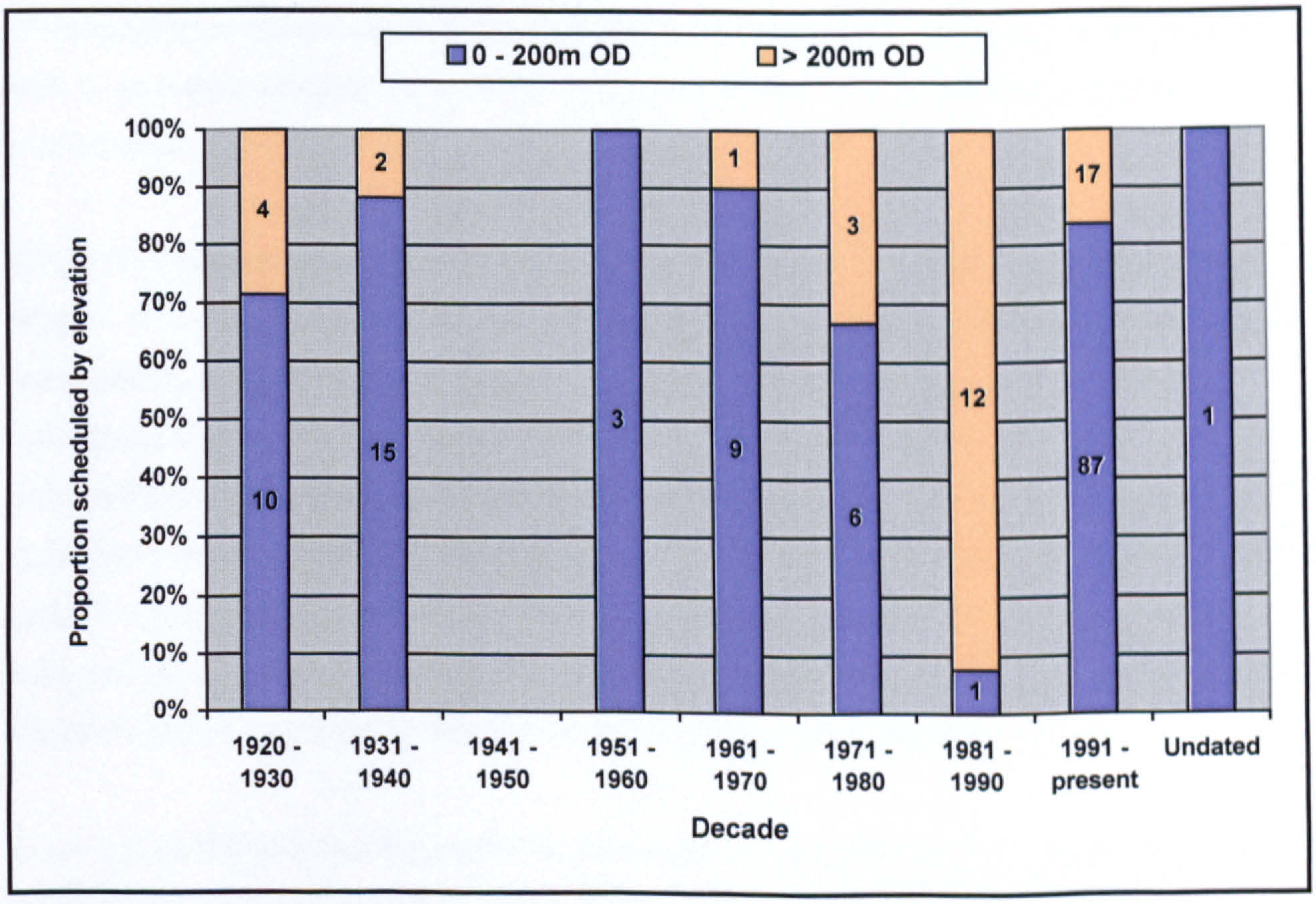

Figure 3.12. Dates of scheduling of sample monuments by elevation.

This increase in the scheduling of monuments in upland settings in the 1980s is illustrated in figure 3.12, which also illustrates that in the 1990s, the majority of new schedulings were of monuments in lowland settings. This increase in scheduled lowland monuments reflects the dramatic increase in the numbers of cropmarks recorded during the 1980s and 1990s. It is worth noting that only seven of the 76 scheduled cropmark monuments in the sample were scheduled before 1990, and that these are all Roman monuments or elements thereof. In the 1990s, new schedulings of cropmark monuments have outnumbered those of extant monuments by two to one, and it is now that case that some 38% of all cropmarks in the sample are now scheduled, compared with only 19% of extant monuments. This apparent bias towards the scheduling of cropmark monuments is partly due to the nature of the sample on which the desk-based study is based. During sampling (section 2.4), all cropmark monuments with no meaningful archaeological classification (such as 'linear cropmark' or 'pits') were removed. Consequently, all cropmarks in the sample can be ascribed an archaeological value (nearly all represent prehistoric settlement sites), and consequently, most can be considered as candidates for scheduling. In contrast, nearly all extant monuments in the overall population from which the sample was extracted were found to have an archaeological classification, leading to the inclusion of monuments in the sample such as farmsteads, individual structures and cultivation remains. Such monuments would seldom warrant consideration as monuments of national importance. As a result, it is perhaps little surprise that there is an apparent lack of scheduled extant monuments relative to numbers of scheduled cropmark monuments.

Of the 171 scheduled monuments in the sample, 108 are in Perth and Kinross, 39 in Angus, 19 in Fife, three in Dundee, and two in Stirling. While these figures mean little in themselves, examining percentages of monuments in each Local Authority area scheduled shows that 40% of sample monuments in Angus are scheduled, compared with 21% in Perth and Kinross and 14% in Fife. These figures reflect recent patterns in Historic Scotland's monuments scheduling programme, through which nearly all field monuments in Angus had been assessed for national importance by 1999. By contrast, the programme of scheduling in Perth and Kinross and Fife is ongoing, explaining the lower percentages of monuments scheduled within these Local Authority areas.

It can be concluded that the patterns observed in monument scheduling since 1920 partly reflect those patterns observed in the dates of monument recording in the NMRS. All the early schedulings are of status medieval sites, stone circles, and Roman monuments, and it was not until the 1970s and 1980s that large numbers of upland monuments were scheduled within the study area. That cropmarks have made up the majority of recent schedulings is due to the discovery of large numbers of easily identifiable cropmarks within the study area over the past three decades. The following sections of this chapter examine some of the archaeological and non-archaeological variables which may affect perceived archaeological distributions outlined. These include altitude, Land Capability for Agriculture (LCA) classification, land use and material construction. Many of these variables are inter-related. For example, land use is determined largely by LCA, which is in turn partly determined by altitude. Nevertheless, the variables are treated separately wherever possible in order to assess fully their relationships with observed monument distribution.

3.5 Land use and sample monument distribution

Through the desk-based study, predominant land cover at each sample monument has been recorded, enabling analysis of monument distribution in relation to land use. Because the land use data have been collected using maps and the LCS88, land use data has been checked against other (more reliable) data sources. This has enabled an accuracy assessment of the desk-based study land use information, and has allowed calibration of land use statistics within the desk-based study, based on the accuracy assessment. The accuracy assessment shows that although overall trends in land use at sample monuments remain unchanged after land use calibration, there are a number of discrepancies and possible inaccuracies that occur within the land use data collected through the desk-based study.

Throughout this and all following chapters, analysis of monument distribution in relation to land use is based upon both calibrated and uncalibrated land use data. Before discussing this analysis, however, it is necessary to examine in some detail the figures produced by the land use calibration exercise in order to illustrate the limitations attached to the use of both the calibrated and uncalibrated land use data.

3.5.1 Assessing the accuracy of the desk-based study land use data

Using vertical and oblique aerial photographs, Historic Scotland Monument Warden reports and a programme of field survey, land use noted through the desk-based study at 258 monuments has been checked. As table 3.2 demonstrates, accuracy of dominant land use information recorded through the desk-based study was found to be about 82%, though this accuracy varies between land use classification categories. A number of factors contribute to these inaccuracies. Firstly, in the desk-based study, many of the monuments have only 6-figure grid references and little or no written description of their location, placing them anywhere within a 100 metre grid square. This contributes to some inaccuracies in recording land use at monuments situated in areas where land cover varies over short distances. Most inaccuracies are as a direct result of using Ordnance Survey 1:10,000 map sheets to determine land cover, as agricultural land is shown either as rough grassland (implying non-improved) or is enclosed, but left blank (implying improved or arable). Many inaccuracies have occurred in classifying land use at monuments in marginal agricultural areas, where land may have been heavily improved in the past but is now marked as rough grazing, or where land, although enclosed, has not all been improved. In all cases where arable land has been misidentified, the corrected land use is either non-arable improved land, or the monument is situated within field margins or small unimproved areas in marginal arable land.

Land Use Classification through desk-based study	Number of monuments checked	Number of cases of correct identification through desk-based study	Percentage of correct land use classifications through desk-based study
Arable / Improved	117	104	89
Non-arable improved	9	2	22
Non-intensive	54	44	81
Semi-natural woodland	14	7	50
Forestry	16	13	81
Developed	2	2	100
Semi-developed	2	1	50
Enclosed	30	27	93
Verge / Field margin	14	11	79
Water	1	1	100
TOTAL	**258**	**212**	**82**

Table 3.2. Numbers of monuments assessed in the accuracy assessment by land use as identified through the desk-based study and through the accuracy assessment.

Another land use type which has proved difficult to identify using LCS88 and Ordnance Survey 1:10,000 map sheets is semi-natural woodland. It is worth noting that only half of cases where semi-natural woodland has been identified as the primary land use through the desk-based study have been found to be accurate. The reasons for this are twofold. Firstly, some areas interpreted as semi-natural woodland have been found to be areas of forestry plantation with small areas of semi-natural woodland included. Secondly, some monuments are situated in areas where, although a few trees are present (and marked on the 1:10000 map sheet), the predominant land cover is not semi-natural woodland. In such cases, it is virtually impossible to classify land use accurately from 1:10,000 maps.

Many inaccuracies have occurred where the monument in question is situated within a small unit of land. Small units of a land use type are difficult to distinguish on 1:10,000 maps, and LCS88 does not map land use units smaller than 10 hectares in extent except urban land use units (5 hectares) and semi-natural woodland (2 hectares). The problems encountered in identifying land use within small land units are compounded by the fact that some of the land uses are not marked very clearly on Ordnance Survey maps. A small parcel of semi-natural woodland, for example, may be marked only by a single tree symbol, or may not be marked at all.

Several cases have been encountered where land use has changed since the publication of the Ordnance Survey 1:10,000 map sheets used and the LCS88. Land use can change in a very short space of time, and it is inevitable that in using sources several years old, inaccuracies will occur. Even in checking land uses using aerial photographs, information was found to be out of date in several cases. None of the vertical aerial photographs used are newer than 1989, though some oblique aerial photographs are more recent in date (late 1990s in some cases). The land use calibration exercise has shown that the only truly reliable method of checking land use is to visit the monument.

By assessing the accuracy of the land use data obtained through the desk-based study in this way, the desk-based study has also been shown to be very simplistic in terms of recording land use. For example, the desk-based study recognises only about 4% of monuments as being situated within more than one land use area. The programme of checking aerial photographs and field survey undertaken as part of the accuracy assessment has shown this figure to be nearer 18%. Most monuments with more than one land use fall into two types. Some have two or more distinct zones of differing land use contained within their overall area, such as a fort where the land use is split between unimproved grazing and semi-natural woodland. In other cases, land use is largely uniform across the monument's extent, but the land use is in effect a 'mosaic' of more than one of the land use classes identified, such as a monument situated in the verge of a field which is also wooded.

3.5.2 Calibration of the desk-based study land use data

Numbers of monuments within each land use category have been counted according to the predominant land use identified through the desk-based study and the predominant land use as identified through the accuracy assessment. By comparing the expected frequency with the observed frequency of monuments within each land use category, it has been possible to estimate the true totals of monuments within each land use group in the desk-based study. For example, of the 258 monuments for which detailed land use information has been obtained, 117 (45.3%) have been identified through the desk-based study as being situated in arable or improved land. After checking land use for each of the 258 monuments, this figure has been found to be only 106 (41.1%), suggesting that total number of monuments located in arable or improved land is approximately 4.2% lower than suggested by the desk-based study.

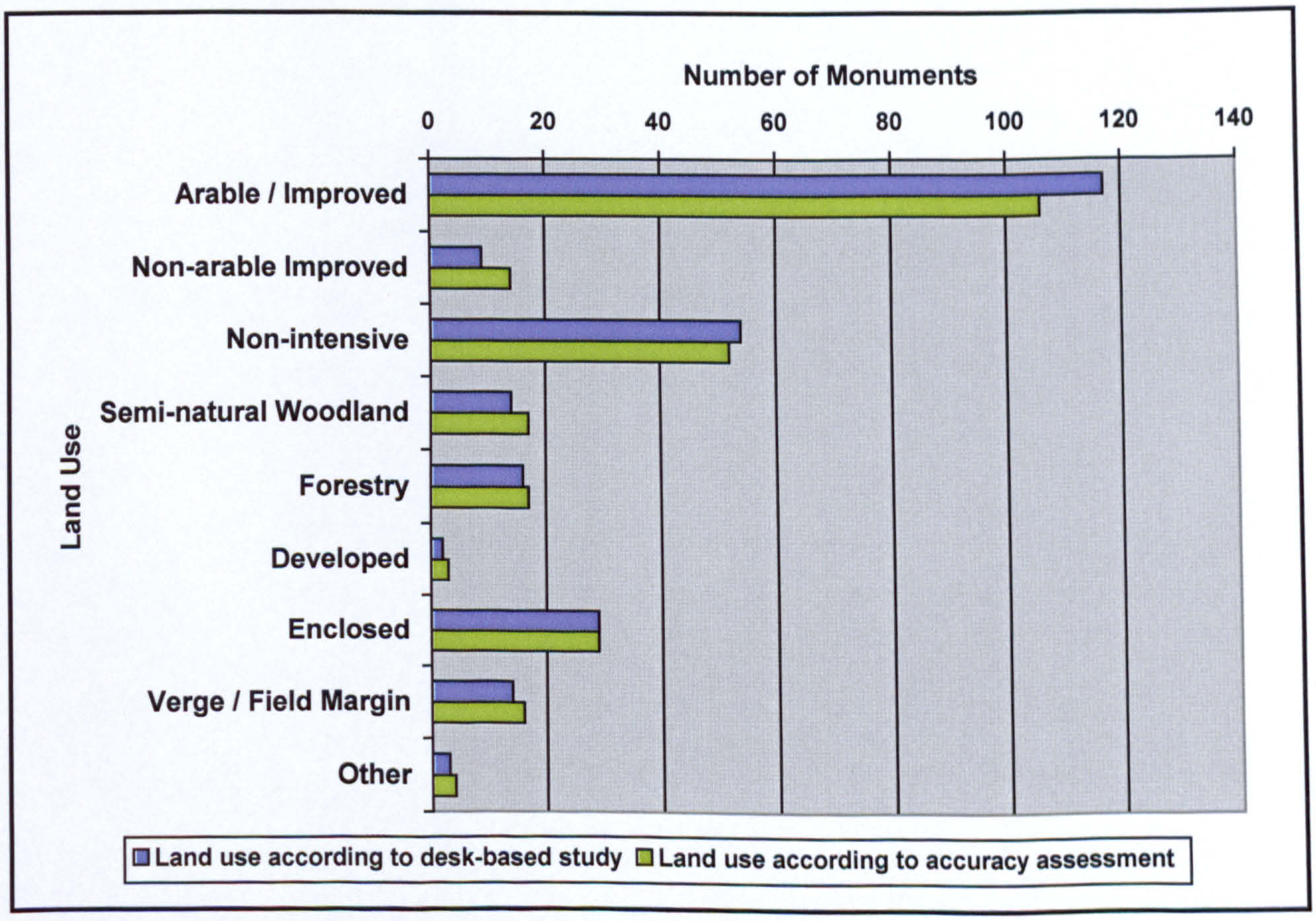

Figure 3.13. Numbers of sample monuments used in accuracy assessment by land use according to the desk-based study and accuracy assessment.

Figure 3.13 demonstrates how the information on land use collected from aerial photographs and field survey compares with the land use data collected through the desk-based study for all land use categories. By extrapolating these variations in expected and observed frequencies of monuments according to land use, it has been possible to estimate the genuine totals of monuments within the desk-based study according to land use. For example, within the desk-based study, 375 (48.1%) of monuments have been identified as being located in arable or improved land. The checks made during the accuracy assessment suggest that the genuine (or calibrated) figure is likely to be about 4.2% lower, giving a total of about 342 monuments (43.9%). Uncalibrated and calibrated totals of monuments by land use are shown in figure 3.14.

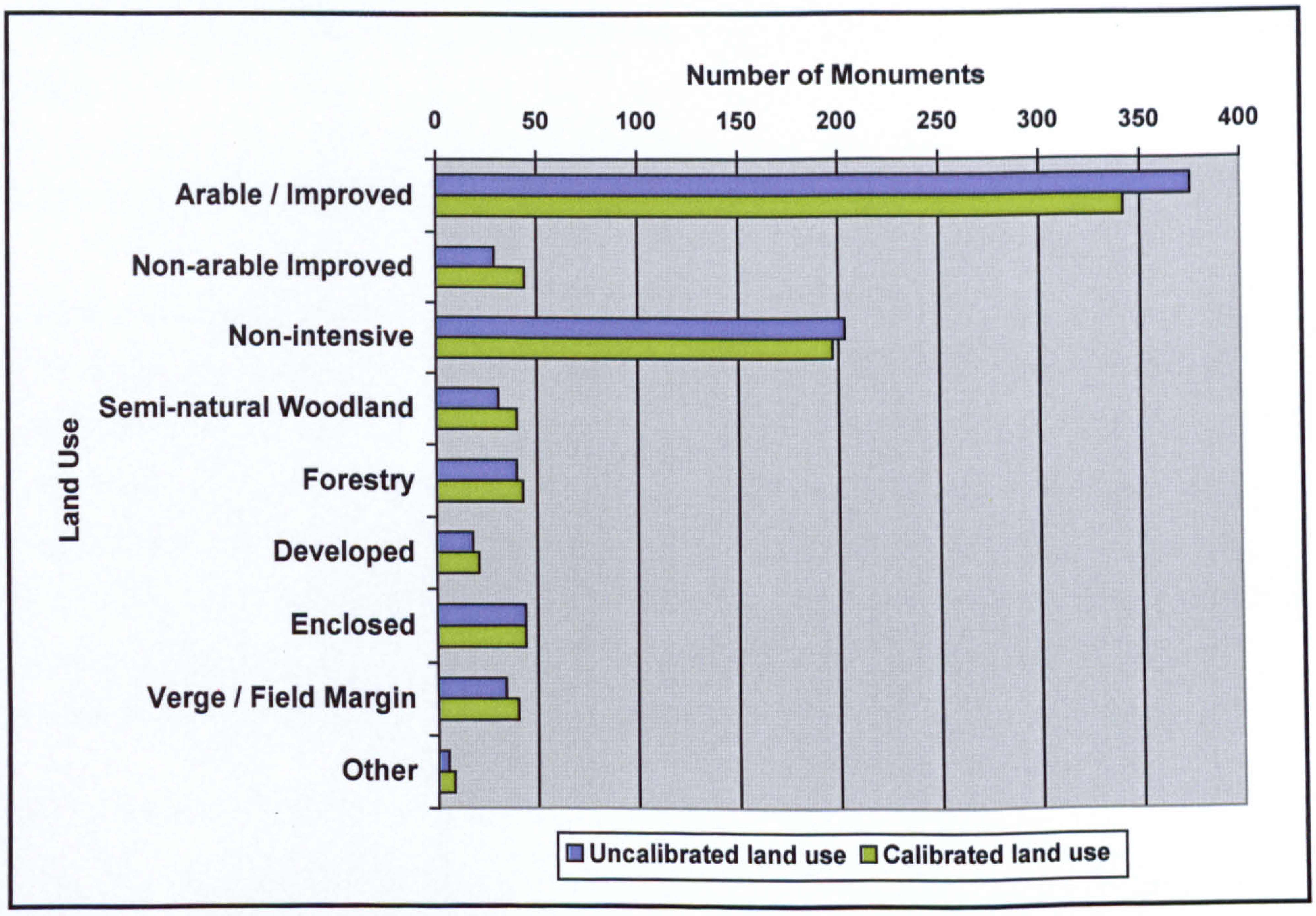

Figure 3.14. Numbers of sample monuments according to land use before and after calibration.

As figure 3.14 shows, monument distribution according to land use has changed slightly after calibration, but overall patterns remain the same. The most notable difference shown in the calibrated data is that there are fewer monuments in land use types which are usually large in extent, (such as arable and non-intensive land uses) than the desk-based study has suggested. Conversely, calibration shows that there are more monuments in land use units which are often smaller in extent (and therefore more difficult to identify using maps and LCS88), such as non-arable improved land, semi-natural woodland and in verges and field margins.

It must be emphasised that the figures shown in figure 3.14 should be regarded as indicative rather than definitive, owing to the small numbers of checks made for some land use types, such as developed land. Furthermore, some methods of checking land use have proved more reliable than others. For example, land use information recorded from vertical aerial photographs before visiting a monument was found on occasion to be inaccurate. This was for two reasons. Firstly, none of the vertical aerial photographs used post-dates 1989, and secondly, land use could not always be determined from the vertical aerial photographs, particularly when a monument was located in a small unit of land. Nevertheless, the calibrated land use data does provide a more accurate indication of monument totals within land use categories than the land use from the desk-based study alone.

3.5.3 Sample monuments and calibrated land use

As the calibrated totals of sample monuments according to land use presented in the previous section show, about half of sample monuments are located within arable or improved land, with about a quarter situated in areas of non-intensive land use. Totals of monuments situated in semi-natural woodland, forestry, enclosures and verges or field margins each account for about 5% to 6% of sample monuments. While these figures are of little interest in themselves, by comparing them with the total areas of land use types in the study area according to the LCS88, it has been possible to calculate densities of sample monuments according to some land uses.

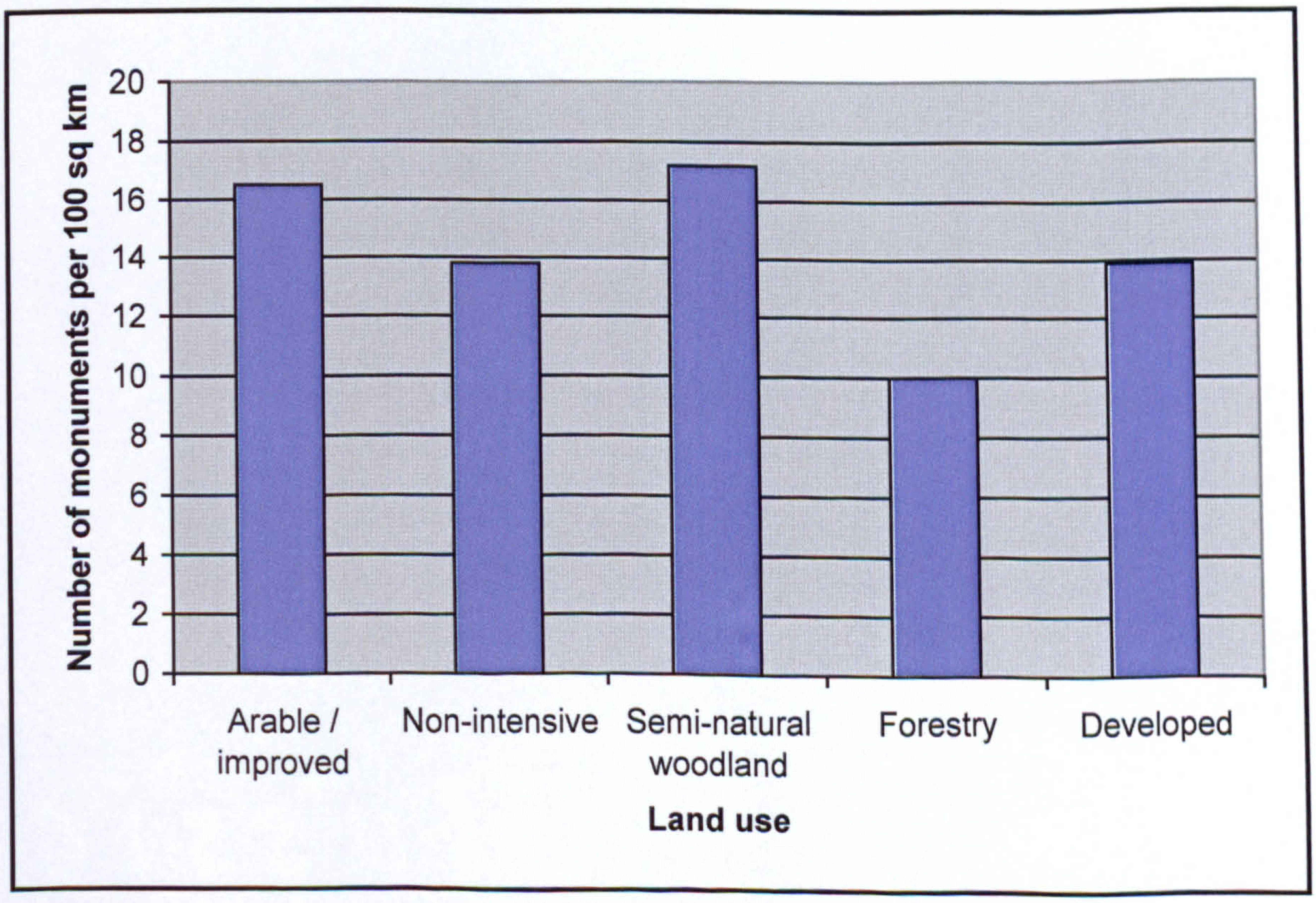

Figure 3.15. Densities of sample monuments by land use class.

Figure 3.15 shows that densities of recorded monuments vary between land uses. The two highest monument densities (about 16-17 sample monuments per 100 sq km) are found in arable / improved land (which includes non-arable improved land) and semi-natural woodland, while developed land and non-intensive land use areas have monument densities of about 14 per 100 sq km. It is likely that some of these differences in recorded monument densities can be attributed to human preference for settlement in low-lying areas. For instance, some 20% of non-intensively used land within the study area is found above 500m OD, but only 5 of the 779 sample monuments are situated over 500m OD. It is perhaps little surprise that there are relatively fewer monuments in non-intensive land use areas than in arable and improved land, all of which is situated below 400m OD. The degree to which cropmarks and non-cropmark buried features such as cists and souterrains contribute to the high density of monuments in arable / improved and developed land is demonstrated in figure 3.16, which shows densities of extant monuments only according to land use.

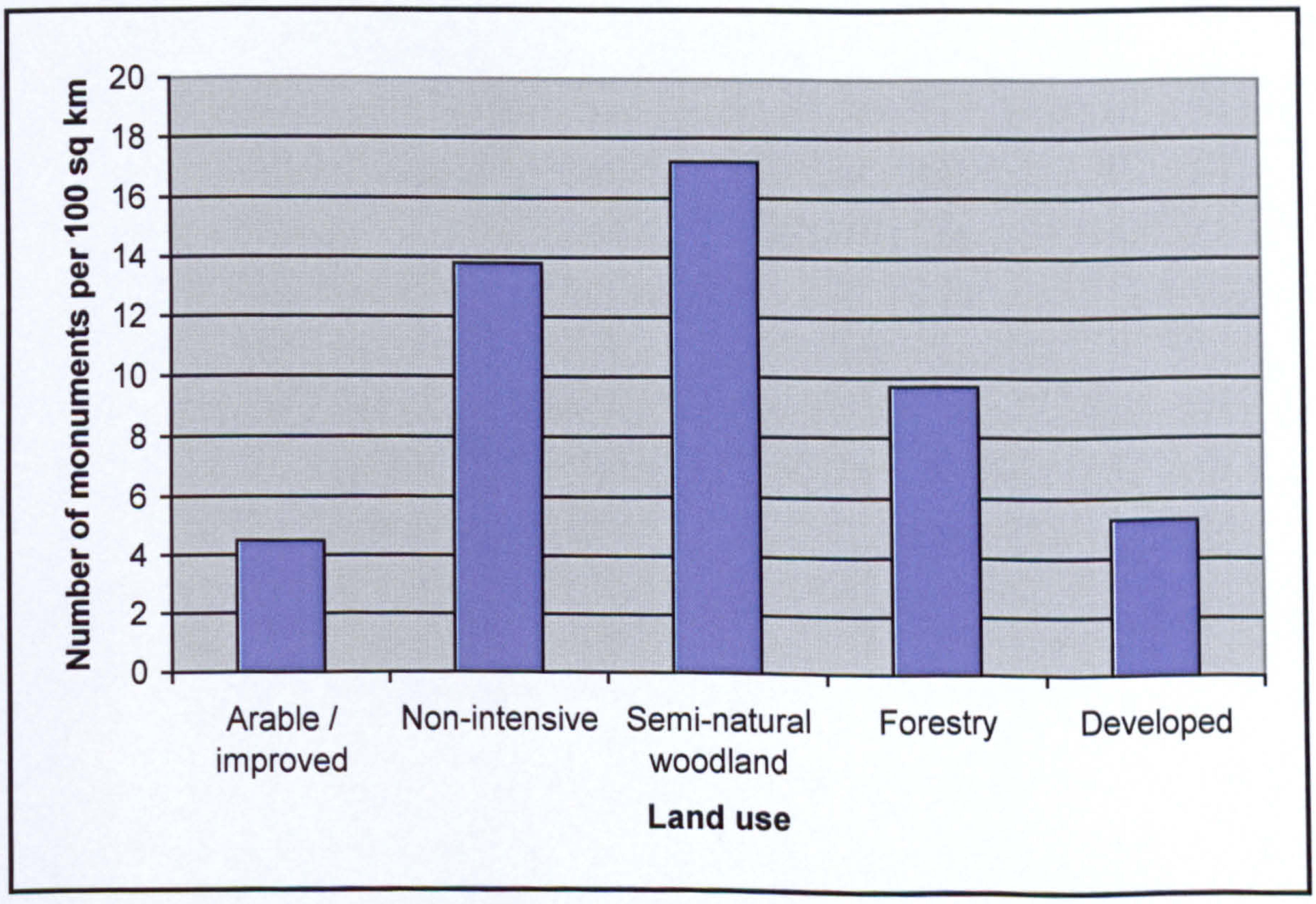

Figure 3.16. Densities of extant sample monuments by land use class.

As figure 3.16, shows, with cropmarks and non-cropmark buried features (such as cists and souterrains) removed from analysis, densities of monuments recorded in arable / improved and developed land drop dramatically. This underlines the importance not only of cropmarks in the identification of monuments in arable land, but also that the mechanisms of disturbance leading to the discovery of non-cropmark buried features are most common in arable and developed land. That such a high density of monuments should be recorded in semi-natural woodland is surprising. The reason for this high density of monuments is not immediately apparent. It is possible that the total area of semi-natural woodland recorded through the LCS88 is an underestimate, as many areas of semi-natural woodland are small in extent and the LCS88 does not map semi-natural woodland where land parcels are smaller than two hectares. Alternatively, it is possible that this density of monuments in semi-natural woodland is genuine, and that a relatively high number of monuments survive and have been recorded in semi-natural woodland within the study area.

The lowest monument density shown in figures 3.15 and 3.16 is among sample monuments in forestry, where only about 10 are recorded per 100 sq km of the land cover type. Again, the reasons for this are difficult to ascertain. Much of the forestry plantation within the study area is found at high altitude, so the lack of recorded monuments here can perhaps be attributed to a human preference for settlement in low-lying areas, creating fewer monuments at these high altitudes. If this were the case, however, the same might be expected of high-altitude land currently given to heather moor and rough grazing, but as figures 3.15 and 3.16 show, recorded monument density within non-intensive land uses is considerably higher than in forestry plantation. It is more likely, therefore, that this lack of monuments found in forestry can be attributed to the difficulties in identification of monuments both from the ground and from the air. It is worth noting that most of the 40 sample monuments recorded through the desk-based study as being located in forestry were recorded before or immediately after planting took place, and that only seven have been first identified in forestry since 1950. Based on these figures, it seems likely that the identification and recording of monuments is indeed hindered by the presence of forestry.

Perhaps the most significant pattern to observe relating to monument density and land use is not illustrated in either figure 3.15 or figure 3.16 at all. Approximately 10% of sample monuments are located either within small enclosures or within field margins or verges. Although the LCS88 does not map field margins or land parcels smaller than two hectares, it is highly unlikely that these land use types account for as much as 10% of the study area. The high number of monuments situated in enclosures and field margins relative to the total area they comprise can be attributed to two factors. Firstly, about three quarters of the enclosed monuments are high status buildings such as churches, castles and tower-houses, many of which will have been enclosed when constructed, and so their situation within an enclosure is by design rather than by accident. Secondly, the relatively high number of monuments found in field boundaries and verges demonstrates their importance in the long-term survival of many archaeological monuments. Many of these are likely to survive by virtue of the fact that they are situated at locations where they have been sheltered from surrounding land uses. These monuments include more vulnerable types than those found within enclosures, such as strips of rig and cup-markings. It is worth noting that of the 175 extant sample monuments located in the arable zone (areas with an LCS88 classification of arable / improved), approximately 30% are situated in enclosures, verges and field margins, and that over 80% of the sample monuments located in verges and field margins are surrounded by arable and improved land. These figures add weight to the argument that the high numbers of monuments found in enclosures and field margins can be attributed at least in part to the sheltered nature of their location.

3.6 Distribution of sample monuments according to elevation

It might be expected that the number of monuments within the sample would diminish with altitude, given the continued human preference for settlement in low-lying areas with favourable climate. This is not the case, however. As figure 3.17 illustrates, the number of recorded monuments within the study area falls away rapidly with altitude up to an elevation of about 150m OD, but within each altitude category up to an elevation of 350m, numbers of monuments recorded remain constant. Indeed, it is worth noting that fewer (63 monuments) have been recorded between 150m and 200m than between 300m and 350m, where 76 monuments are recorded.

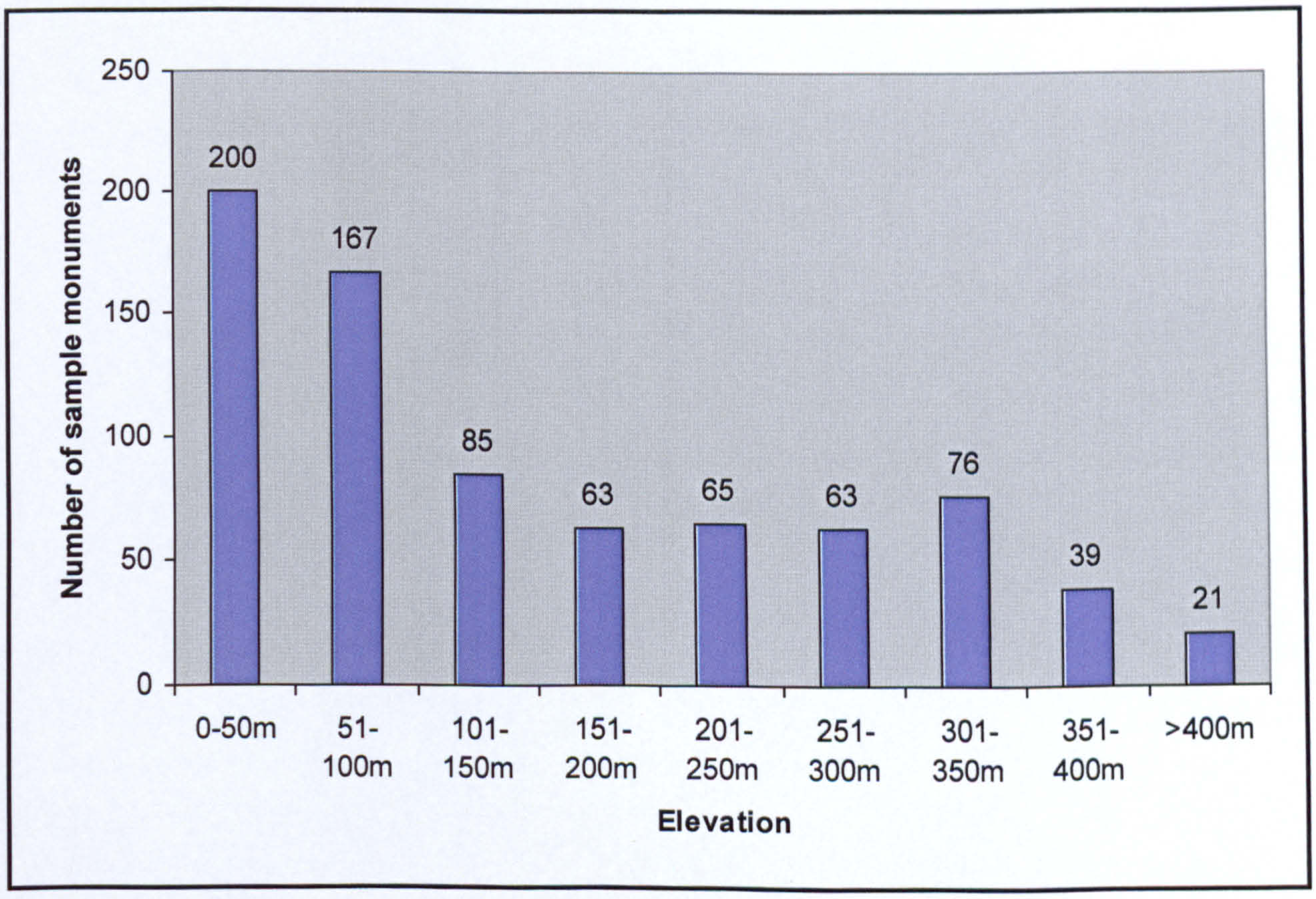

Figure 3.17. Numbers of sample monuments according to elevation.

This 'trough' is even more pronounced when density of sample monuments is examined. Table 3.18 shows numbers of sample monuments per 100 square kilometres of land within each elevation category, and shows that in land lying between 100m and 200m OD in the study area, there is a marked paucity of recorded monuments. This variation in recorded monument density is also shown in table 3.3.

Elevation (m OD)	Land area within elevation category (sq km)	Number of sample monuments in elevation category	Number of sample monuments per 100 sq km
0-50m	652	200	30.7
50-100m	853	167	19.6
100-150m	790	85	10.8
150-200m	540	63	11.7
200-250m	383	65	17.0
250-300m	311	63	20.3
300-350m	285	76	26.7
350-400m	250	39	15.6
> 400m	623	21	3.4
TOTAL	4688	799	16.6

Table 3.3. Numbers and densities of sample monuments according to elevation category

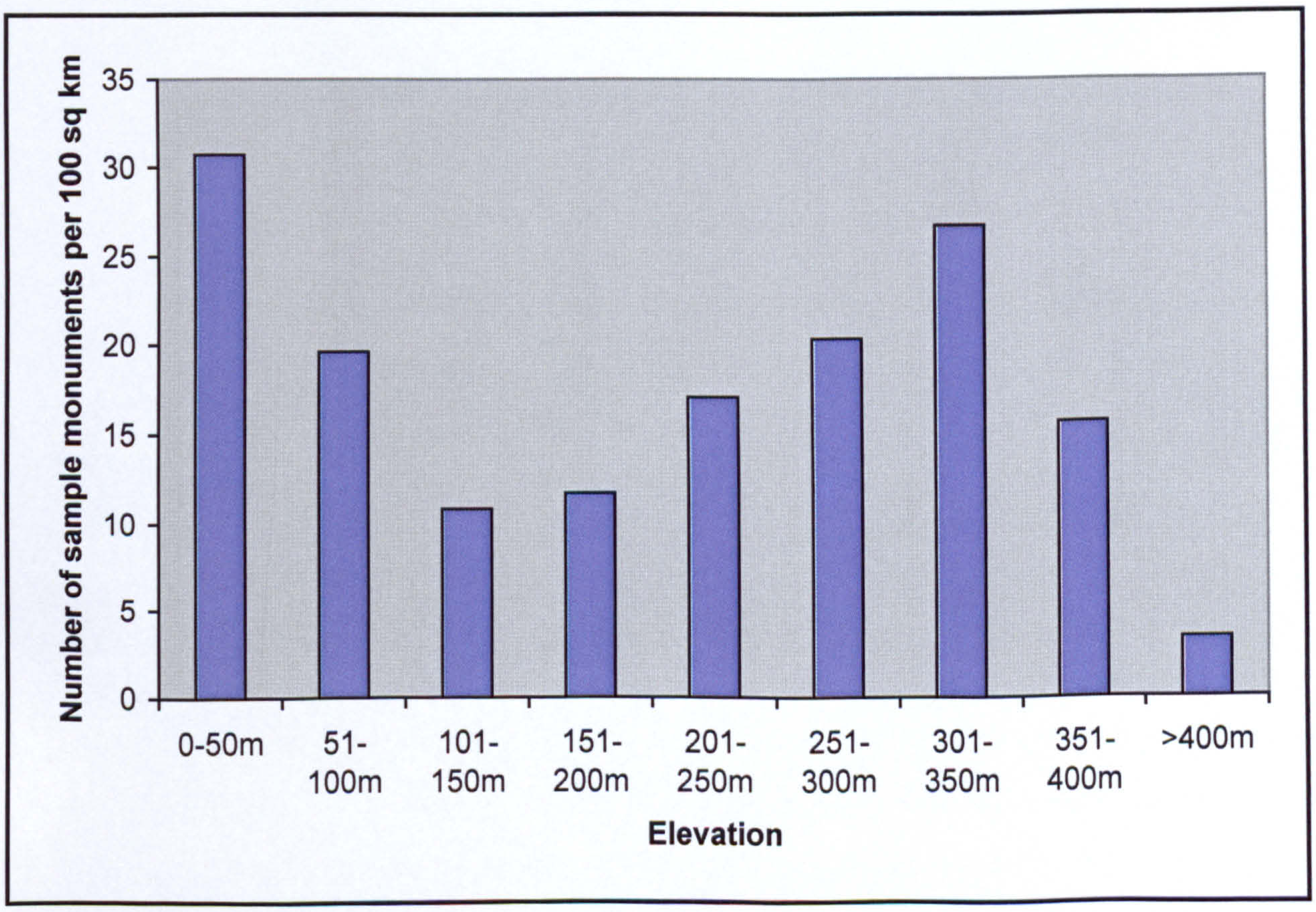

Figure 3.18. Densities of sample monuments according to elevation category.

As figure 3.18 demonstrates, recorded monuments in the study area are relatively scarce between 100m and 200m OD, with a lower density of monuments recorded here than in any other elevation category except over 400m OD. It is possible that this pattern reflects zones of destruction and survival, and that the 'trough' in the elevation distribution reflects areas of improved pasture, where extant archaeological remains have been removed but where cropmarks are rarely recorded. This argument is supported by an examination of densities of cropmark monuments within each elevation category. Figure 3.19 shows both the densities of cropmark monuments within arable / improved land in each elevation category and the area of arable and improved pasture within each elevation category according to the LCS88.

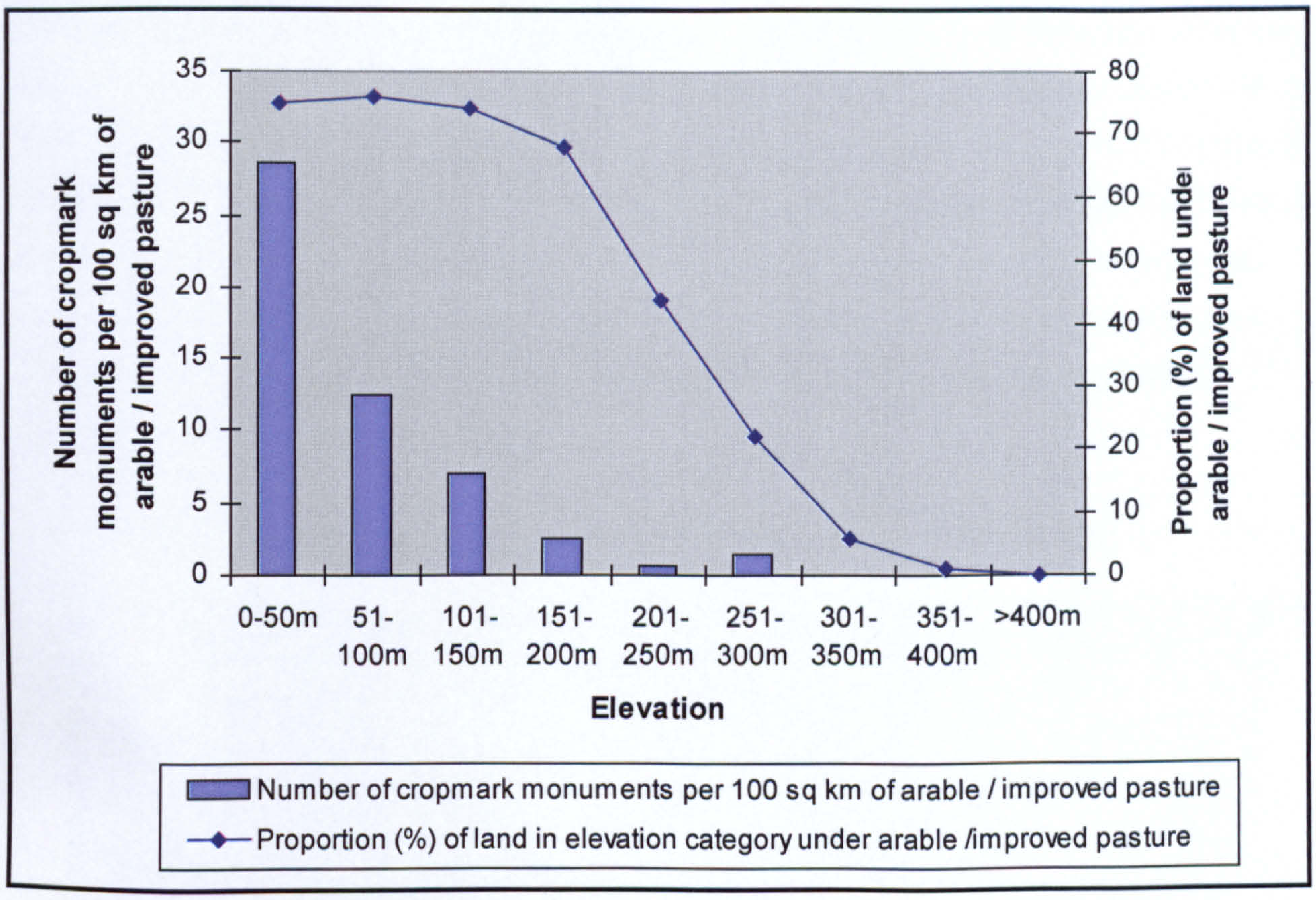

Figure 3.19. Densities of cropmark sample monuments according to proportion of land in each elevation category made up of arable and improved pasture.

Figure 3.19 demonstrates that within the study area, although numbers of recorded cropmark monuments per square kilometre of arable and improved pasture diminish rapidly with altitude, areas of arable and improved pasture account for over 70% of land up to about 200m OD, and still account for nearly half of land situated between 200m and 250m OD. Consequently, numbers of recorded cropmarks are very high in land below 100m OD (219 monuments), but between 100m and 200m OD, this figure drops to only 51 cropmark monuments. Between 200m and 250m OD, numbers of recorded cropmarks are negligible (one), yet nearly half of the land area in this elevation category is made up of arable and improved pasture. This suggests that between 100m and 250m OD, the majority of the land can be regarded as a zone in which the recording of cropmarks is relatively rare, and arable or improved land within this elevation category might thus be regarded as a negative information zone.

The balance of recorded sample cropmark monuments according to elevation is redressed considerably, however, when extant recorded monuments are examined. Figure 3.20 shows densities of extant and cropmark sample monuments according to elevation. As figure 3.20 shows, recorded extant monuments below 200m OD are relatively sparse, while by comparison, recorded extant monuments between 200m and 400m OD are relatively abundant. Below 100m OD, the paucity of extant monuments is offset by the density of cropmark monuments, and above 200m OD, the lack of recorded cropmarks is offset by the abundance of extant monuments recorded. Between 100m and 200m OD, however, there are low densities of both cropmark and extant monuments. Consequently, this zone does indeed appear to be a negative information zone in which agricultural improvements have removed extant traces of monuments, but where cropmarks are recorded infrequently.

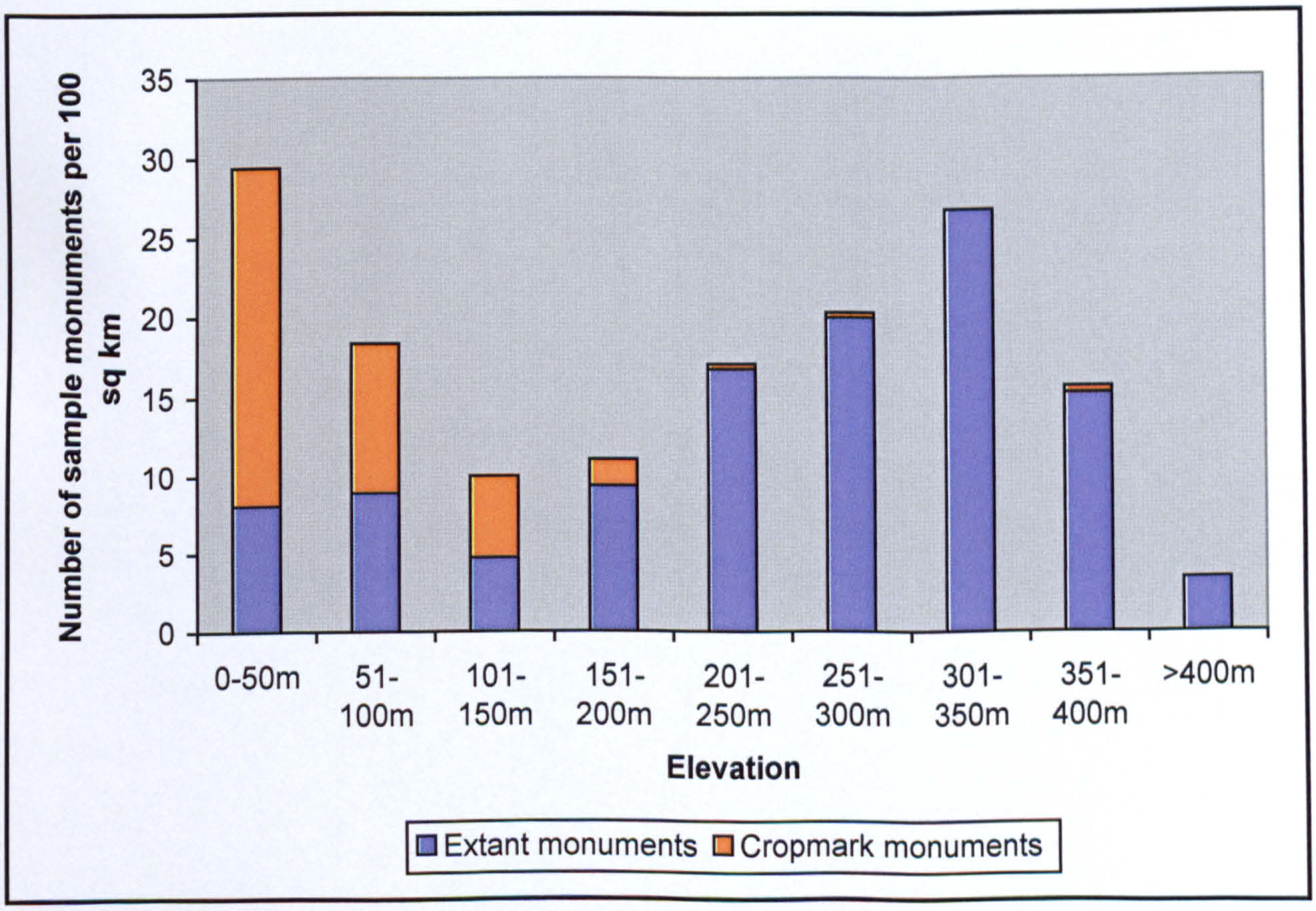

Figure 3.20. Densities of extant and cropmark sample monuments according to elevation category.

While it seems unquestionable that land (particularly agricultural land) between 100m and 200m OD is a negative information zone, it is unclear to what extent the lack of recorded cropmark monuments in this zone is attributable to a lack of cropmark formation and to what extent it can be attributed to a lack of survey. Stevenson (1975) has suggested that the perceived distribution of archaeological monuments is determined not only by the survival of monuments, but also by the potential for their discovery. In this negative information zone between 100m and 200m OD, therefore, it is possible that although many extant remains have been removed by agricultural improvements, significant features and deposits lie beneath the ground surface, but that a lack of cropmark formation at this altitude has precluded the possibility of these features and deposits being discovered. An alternative explanation is that the trends observed demonstrate a lack of archaeological survey in more marginal arable land. Cropmarks are obvious at low altitudes, while upstanding monuments are obvious at higher altitudes in areas of unimproved grassland or heather moor. Consequently, monuments in marginal agricultural land, which may be more ephemeral in nature owing to land improvements, may have been overlooked as surveyors have sought to increase numbers of recorded monuments by concentrating on locations where good returns are guaranteed. Cowley (2002) has argued that distributions of cropmark monuments in Scotland are subject to a number of biases introduced by patterns in aerial reconnaissance, whereby low-altitude locations ('honey-pots') known to be reliable in producing cropmarks are flown repeatedly over a number of years and will continue to produce significant numbers of previously unknown cropmark monuments. Using part of Dumfries and Galloway as a study area, Cowley has pointed out that in concentrating on these 'honey-pots', strategies employed during aerial reconnaissance can create self-affirming biases in perceived monument distributions.

Within the sample is a cropmark enclosure at Redlatches, Angus (NMRS no. NO25NW 17) which helps to illustrate the potential implications of the lack of recorded cropmarks in more marginal arable and improved pasture for buried archaeological remains. The cropmark (figure 3.21) was photographed by chance in June 1949 in small strip of cultivated land measuring approximately 500m by 150m, surrounded on all sides by heather moor and rough grazing. The monument is at an extraordinarily high altitude of 358m OD, and the fields in which it sits have now reverted to permanent pasture. It has not been photographed since 1949, and it is likely that this enclosure will never be seen again as a cropmark. Were it not for a single chance photograph in 1949, when lighting and crop conditions were conducive to its detection, the monument would remain unknown. It is surely naïve to deny that other archaeological remains must exist within these marginal improved areas but which have never been recorded either as extant remains or cropmarks.

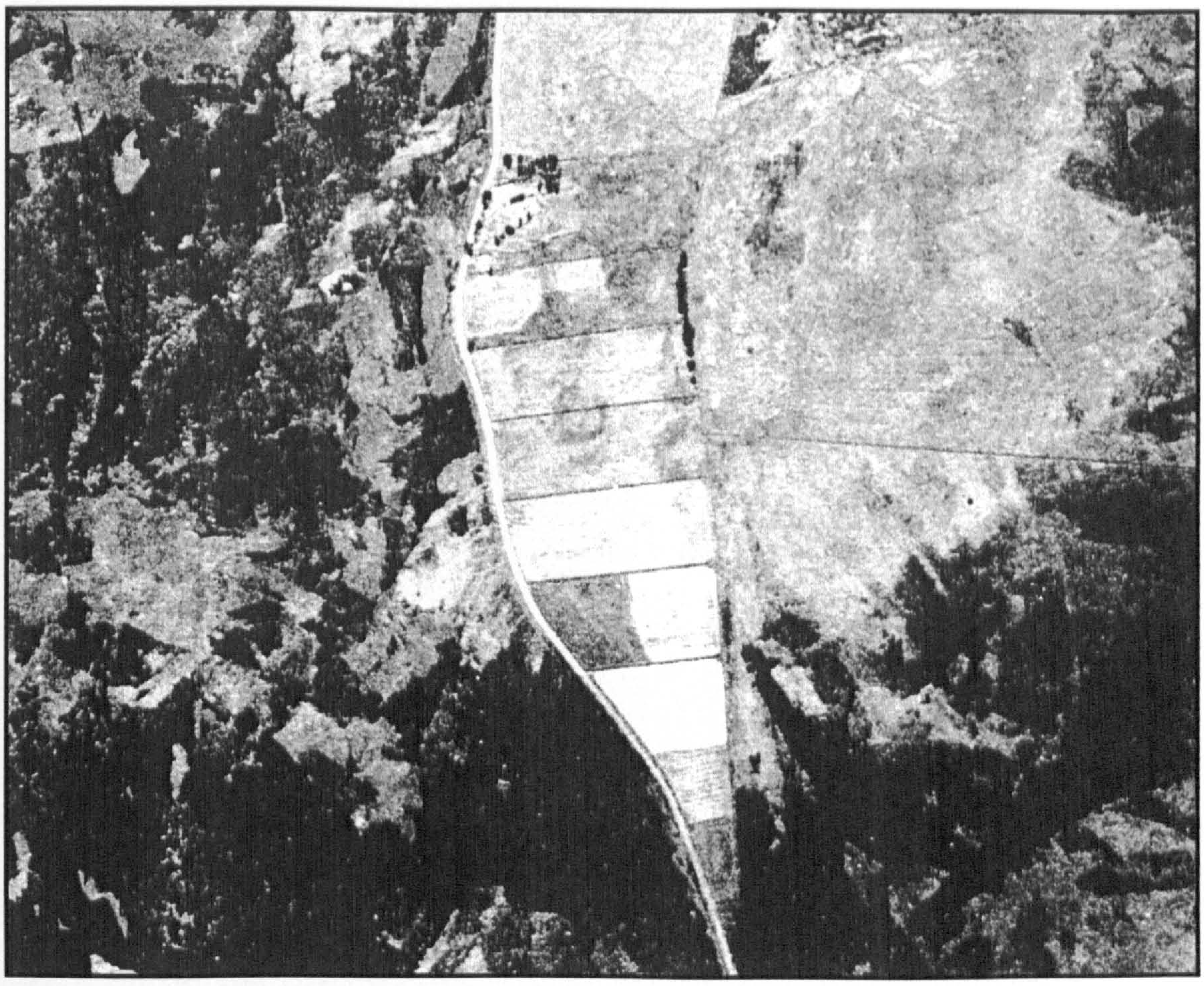

Figure 3.21. Vertical aerial photograph (1949) showing cropmark enclosure at Redlatches, Angus. Pt. 541/A/477 3102. © *Crown Copyright RCAHMS.*

As agriculture in the UK continues to de-intensify, a slow contraction of the area of land cultivated may increase the size of the negative information zone. While this in itself may have positive implications for any archaeological remains present, it decreases significantly the chances that the remains will ever be identified, leaving them highly vulnerable to damage, should a change in land use occur. Barclay (1992b) and, more recently, Carter (2002, 212) have discussed the implications for archaeological remains within marginal agricultural land, specifically with reference to the recent trend in forestry planting at lower altitudes. Agricultural and Horticultural Census data shows that farm woodland within the study area almost doubled in extent between 1989 and 1999, from 7652 ha (2.3% of farm land) in 1989 to 13970 ha (4.2% of farm land). The extent to which this has been at the expense of improved pasture is unclear. Given the Scottish Executive target of 25% of Scotland's land cover to be woodland by the year 2050 and the continued incentives to farmers to diversify through initiatives like the Farm Woodland Grant Scheme, it is likely that afforestation will continue to increase in areas of improved land, including marginal agricultural land.

3.7 Distribution of sample monuments and Land Capability for Agriculture

The classification system for Land Capability for Agriculture (LCA) grades land according to the extent to which its physical characteristics (soil, climate and relief) impose long term restrictions on its agricultural use (MLURI 1991, 1). Although LCA is not a physical characteristic in itself, it helps to summarise the character of land within defined spatial units and the defines likely land uses within these units. As a result, it is a variable worth examining to try to identify any further relationships between monument distribution and physical characteristics of the land within the study area. By examining the LCA classifications for each of the monuments in the desk-based study, it has been possible to identify zones within the study area according to LCA classification where monuments are recorded in abundance, and other zones where there appears to be a relative scarcity of recorded archaeological remains.

LCA Classification	LCA Class area (sq km)	Number of monuments in LCA area	LCA area as percentage of study area	Percentage of sample monuments in LCA area	Monuments per 100 sq km
No Class	238	9	5.1	1.2	3.8
2	474	106	10.1	13.6	22.4
3	1740	341	37.1	43.8	19.6
4	504	74	10.8	9.5	14.7
5	840	186	17.9	23.9	22.2
6	883	62	18.8	8.0	7.0
7	9	1	0.2	0.1	10.6
TOTAL / AVERAGE	**4688**	**779**	**100**	**100**	**16.6**

Table 3.4. Land area, monument numbers and monument densities according to LCA classification.

Table 3.4 shows a variety of information on LCA classification areas within the study area and numbers of monuments in the sample according to these LCA classifications. As might be expected, monument distribution is skewed towards good agricultural land, with some 57.4% of monuments situated in land with an LCA classification of 2 or 3, despite these classifications accounting for only 47.2% of land within the study area. Comparatively few monuments are situated in land with LCA classifications of 6 and 7, with only 8.1% of monuments situated in land which accounts for some 19% of the study area. As the bulk of land with an LCA classification of 6 or 7 is situated at high altitude, and as this land is considered least favourable for agriculture, it is perhaps no surprise that there is a relative paucity of monuments in such areas.

The two LCA classes which show unexpected patterns in monument numbers are classifications 4 and 5. LCA classification 5 land contains a surprisingly large number of monuments, with a monument density almost as high as LCA Class 2 land. In contrast, Class 4 land contains relatively few monuments, with a monument density of fewer than 15 per 100 sq km, compared with around 19 to 22 monuments per 100 sq km for Class 2, 3 and 5 land. As with the analysis of monument densities carried out in relation to elevation, it seems likely that land use and recording patterns have contributed to this paucity of recorded monuments in LCA Class 4 land.

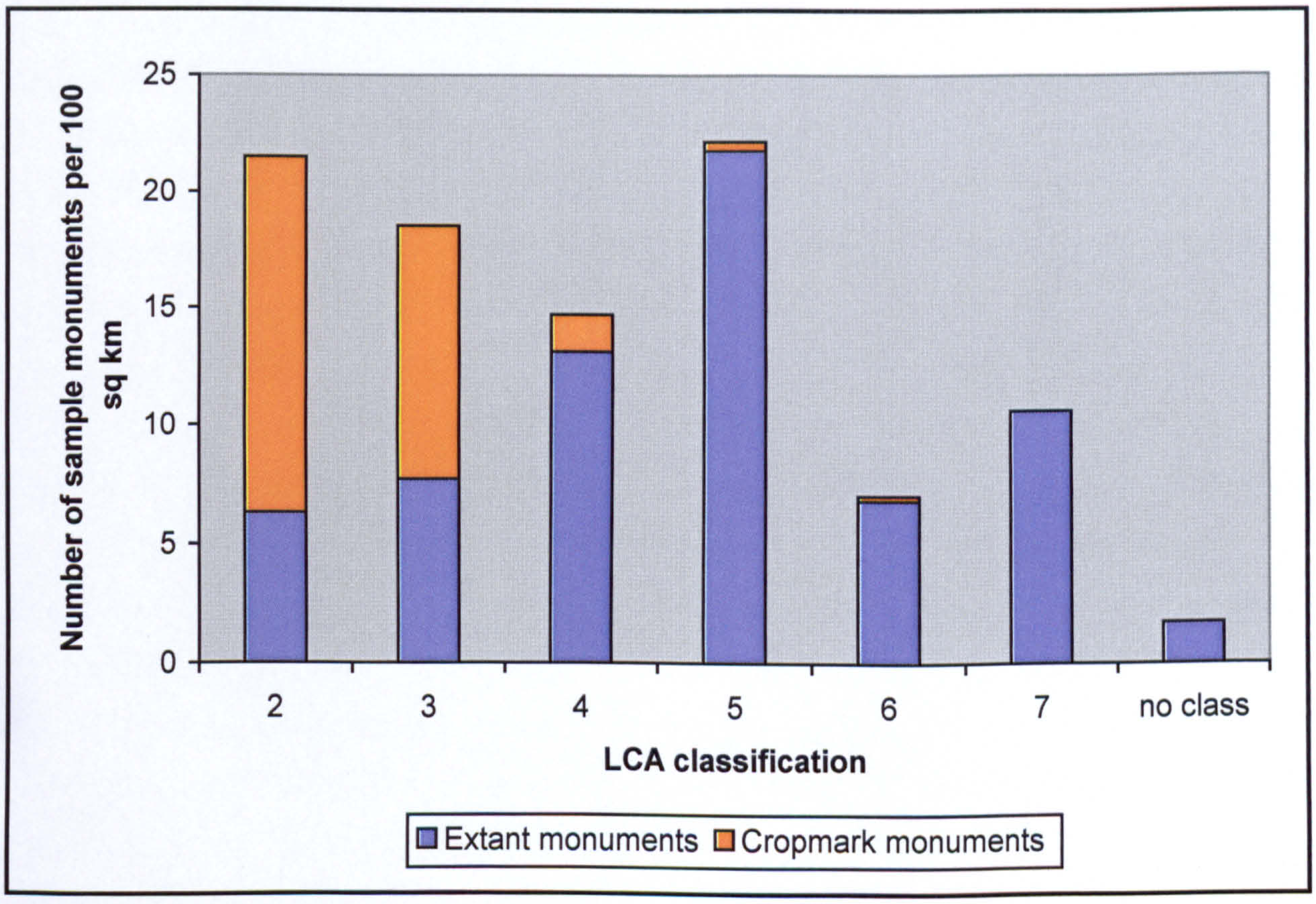

Figure 3.22. Densities of extant and cropmark sample monuments according to LCA classification.

Figure 3.23 shows densities of cropmark and extant monuments in the sample according to LCA classification. As figure 3.24 demonstrates, cropmarks account for the majority of recorded monuments in Class 2 and 3 land (where the LCS88 suggests that arable and improved pasture make up over 80% of land). By contrast, only a small proportion (about 12%) of monuments in Class 4 land are cropmarks, despite nearly 60% of Class 4 land having an LCS88 classification of arable or improved pasture. These figures suggest that cropmark formation and recording may be limited in LCA Class 4 land.

LCA Classification	Area of Arable / Improved Pasture (square km)	Number of Cropmarks	Number of Cropmarks per 100 sq km of Arable / Improved Pasture
2	414	72	17.4
3	1340	191	13.6
4	287	9	3.1
5	153	3	2.0

Table 3.5. Cropmark densities in arable and improved pasture according to LCA classification.

Table 3.5, which shows densities of cropmarks according to total area of arable / improved pasture within LCA classes 2, 3, 4 and 5, demonstrates that cropmark formation is indeed closely linked to the LCA classification of agricultural land. Class 2 land (capable of producing a wide range of crops) has a cropmark density of about 17 cropmarks per 100 sq km of arable / improved pasture, while Class 3 land, which is more restrictive in the range of crops it can support, has a density of about 13 per 100 sq km. In Class 4 land, however, cropmark density drops to three per 100 sq km of arable / improved pasture, and further still to two per 100 sq km in Class 5 land. Arable land and improved pasture account for only about 18% of Class 5 land, with 55% under non-intensive land uses such as rough grazing. Consequently, a large number of non-cropmark monuments are recorded in Class 5 land. In Class 4 land, however, arable and improved pasture make up nearly 60% of land area, and non-intensive land uses account for only 20% of Class 4 land. Consequently, it is reasonable to suggest that LCA Class 4 land is, in relative terms, a negative information zone, given its high proportion of arable and improved land and low incidence of recorded cropmarks.

3.8 The material construction of the sample

At an early stage of the research, each of the monuments in the sample was assigned a category according to the materials from which it was constructed. The types of monuments included in each group are described in section 2.5.2. The categories of monument construction type assigned and the numbers of monuments within each category are shown in figure 3.25.

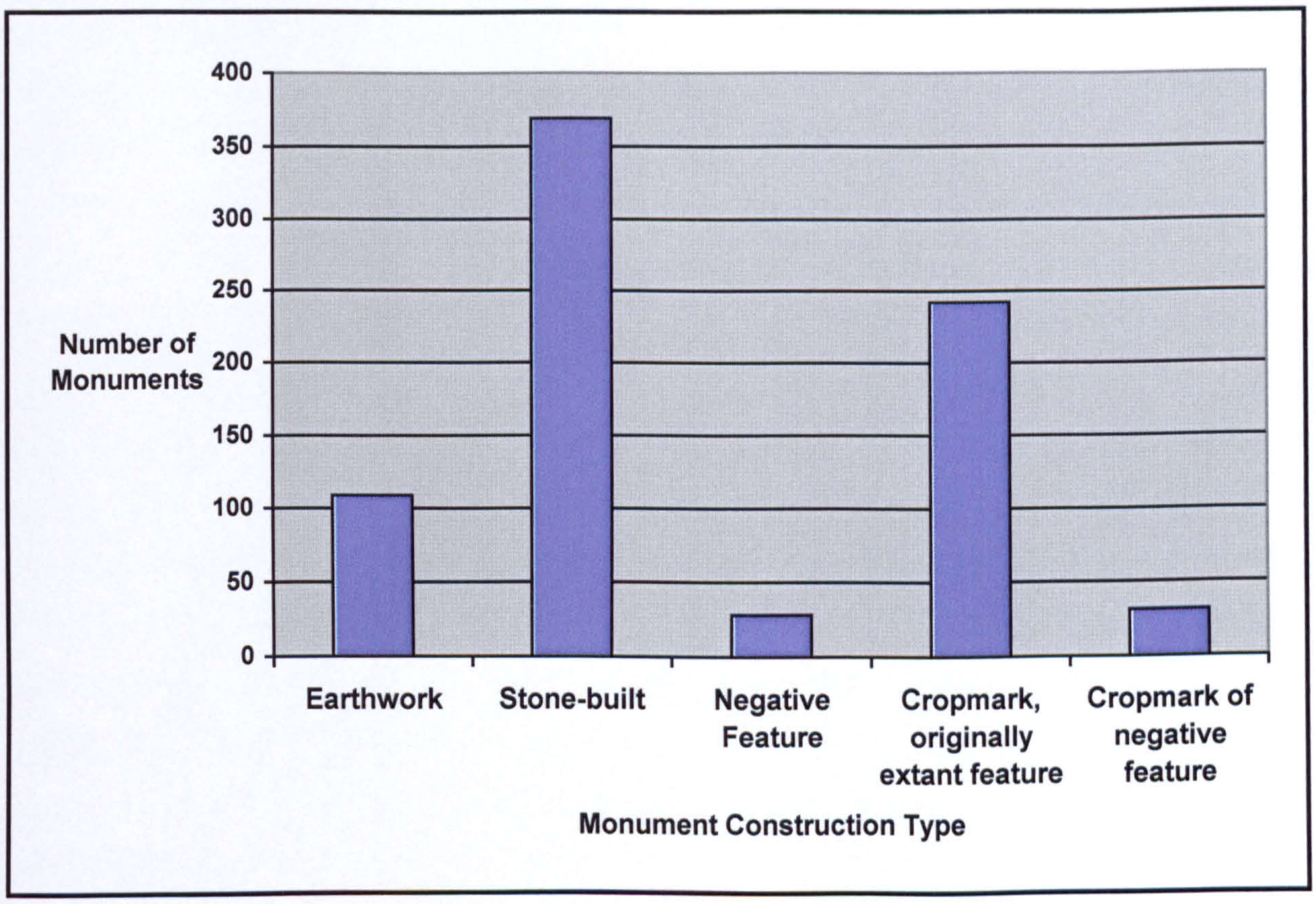

Figure 3.25 Numbers of sample monuments according to construction type.

As figure 3.25 shows, about 47% of sample monuments are primarily of stone construction, and only about 14% of monuments in the sample are of earthwork construction. About 8% of sample monuments are negative features or cropmarks of monuments constructed as negative features, such as cists and souterrains. The remaining 31% of sample monuments are cropmarks of monuments constructed as extant features. As described in chapter 2, during data collection, cropmarks representing formerly extant monuments were sub-divided into two groups: those representing the remains of earth-built monuments, and those representing the remains of stone-built monuments. It is worth noting that only one cropmark could be demonstrated as representing an extant monument originally of stone construction, and all other cropmarks were thought to represent the remains of extant earthwork monuments. While this appeared to imply a much better degree of preservation in monuments of stone construction, in reality, this apparent paucity of cropmark monuments in the sample that were originally predominantly of stone construction is likely to have been influenced by other factors.

Firstly, within the NMRS, many cropmark monument records do not contain a text report. During data collection, unless stone material in the cropmark could be demonstrated, all monuments were assumed to be predominantly of earthwork construction, as it is usually the negative elements of the monument that show as cropmarks, and it is very difficult to identify the presence of stone-built features. The second factor to explain the paucity of cropmark monuments originally of stone construction is that many of the stone built extant monument types do not have cropmark equivalents. For example, if a stone hut circle is removed by agriculture, unless there is an associated ditch or scooped areas have been incorporated into the monument's construction, the hut circle will seldom form a cropmark. If there is an associated ditch or floor deposits remain, these may eventually form cropmarks, but these cropmarks will not be classified as a hut circle. Some excavated examples of cropmark monuments within or close to the study area have included stone construction (e.g. Driscoll 1997), but without excavation, these monuments can seldom be classed as being of stone construction. While it is worth noting that only one cropmark in the sample could be *demonstrated* as representing an extant monument originally of stone construction, for the reasons outlined, the distinction was abandoned at an early stage of the analysis. Consequently, for all further analysis of monument construction type, cropmarks have been divided into those representing negative structures such as souterrains and those representing formerly extant features.

It should be noted that four of the monuments in the sample are part cropmark and part extant. This has occurred where arable land use extends over only part of the monument, leaving part of he monument upstanding. Within the desk-based study, each of these monuments has been recorded as being either cropmark or extant, depending on which of the two conditions the majority of the monument consists. A further five monuments in the sample are visible both as cropmarks and as amorphous mounds or hollows in arable land. Again, these are classified as either cropmark or extant, depending on which of the two monument construction types dominates. There has been a degree of subjectivity in determining the dominant state of the such monuments, but as a general rule, those monuments identified first as cropmarks are classed as cropmarks, while those recorded first as extant remains are classed as extant.

3.8.1 Monument construction material and land use

As noted in section 3.5.1, following checks made during the accuracy assessment using a combination of aerial photographs, Monument Warden reports and field survey, a number of inaccuracies were found in the land use data recorded through the desk-based study. For that reason, monument type distribution in relation to land use is examined here primarily according to calibrated land use. Uncalibrated land use figures are referred to also, if only to help illustrate the changes in the statistics following calibration.

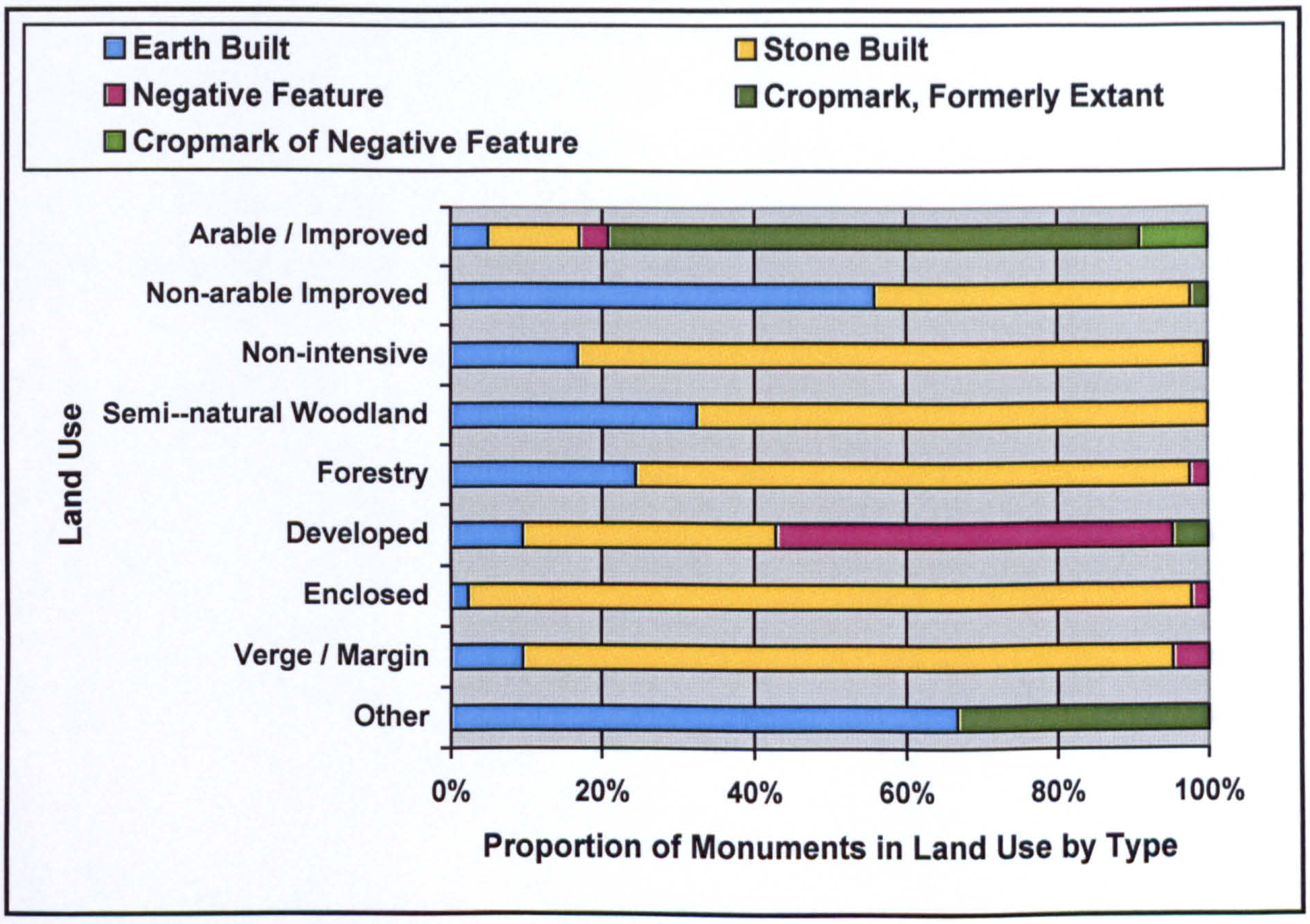

Figure 3.26. Calibrated proportions of monuments by construction type, according to the land use (calibrated) in which they are located.

Figure 3.26 shows likely percentages of monument construction type according to calibrated land use, and demonstrates that in arable and improved land, only about 5% (7% uncalibrated) of recorded monuments are of earthwork construction, while stone-built monuments account for a further 12% (15% uncalibrated). About 4% are negative features, although most of these have been discovered only in the process of destruction, and 79% (75% uncalibrated) of recorded monuments are cropmarks, either of formerly extant sites or negative features. In non-arable improved land, numbers of monuments recorded are small, and consequently, the differences between calibrated and uncalibrated figures are marked. Calibrated figures suggest that about 56% (28%

uncalibrated) of monuments in non-arable improved land are earthwork, and a further 42% (69% uncalibrated) are of stone construction.

In areas of non-intensive land uses, semi-natural woodland and forestry, stone-built monuments predominate, with only about 21% (19% uncalibrated) of recorded monuments within these land use categories of earthwork construction. This pattern is even more pronounced among monuments found in enclosures or within verges and field margins, where 90% (80% uncalibrated) are of stone construction. In developed land, about half of recorded monuments are negative features, and as with negative features recorded in arable and improved land, the majority of these have been discovered only in the process of destruction. Within all but one of the land use categories, it can be seen that earthworks are outnumbered by monuments of stone construction, but the most telling trend shown in figure 3.26 is that recorded extant monuments (particularly earthworks) are scarce in arable and improved land.

3.9 Census summary

In characterising the distribution of monuments within the study area, it has been shown that monument survival and detection are related to (though not necessarily dependant on) a number of inter-related variables, most of which are defined by the physical characteristics of the study area. Monument distribution in relation to each of the variables outlined in this chapter and its implications for archaeological study, survey and resource management are discussed in greater depth in chapter 7, but it is worth summarising some of the salient findings from the census here.

First, the data on which the census (and the following chapters) is based is subject to a number of inconsistencies, with quantities of information varying between monument groups. For example, the majority of early records are of prominent or status monuments such as churches, tower-houses and stone circles, while later records include a much higher proportion of low-status sites such as shielings and cultivation remains. Of the 40 or so 'status' monuments such as tower-houses, castles and churches, only five have fewer than two dated records in the NMRS, and about half have three or more dated NMRS descriptions, owing to significant antiquarian interest in these monuments. By contrast, most of the cropmarks in the sample have no written description, owing to their relatively recent discovery.

Second, sample monument distribution can be seen to vary according to a number of the variables examined. Densities of recorded monuments are highest in semi-natural woodland and arable / improved land (although most of those in arable land are cropmarks), and lowest in forestry. Furthermore, a disproportionately large number of monuments have been recorded in enclosures and field margins, particularly at low altitudes. The significance of altitude in determining monument distribution is not confined simply to those monuments found in enclosures, however. Densities of sample monuments are particularly high between 0m and 100m OD, where cropmark formation and recording is significant, and between 250m and 350m OD, where monuments have largely escaped the impacts of land improvements. By contrast, recorded monument density is particularly low between 100m and 200m OD. Similar variations in monument density exist within the sample according to Land Capability for Agriculture classification, with high densities of monuments noted in LCA Class 2, 3 and 5 land, while monument density in LCA Class 4 land is markedly lower.

By examining monument distributions, the census has illustrated patterns in the survival and detection of archaeological monuments in relation to a number of variables. Further to this, it has given indications of points within the landscape where field monuments are likely to have been subject to pressures of land use and consequently, may be scarce. As the primary concern of the census has been to examine distribution of recorded monuments, all of the analysis undertaken has treated each of the monuments in the sample as unchanged in condition from the time they were first recorded, irrespective of their current condition. Many of the monuments in the sample have been damaged or destroyed since 1850, however, and so the census is simplistic in terms of some of its analyses. The desk-based study has enabled analysis of the changes in monument condition since 1850 in relation to each of the variables examined in the census. This analysis of condition change is described in chapters 4 and 5.

Chapter 4

4 Monument condition change since 1850

In chapter 3, the census has addressed the first of the over-arching research objectives, by producing a sample-based census characterising the distribution of recorded archaeological monuments within the study area in relation to a number of environmental variables. Within the census, however, the condition of each monument has been treated as static (either cropmark, buried or extant) and no attempt has been made to quantify or analyse any changes in monument condition. In this chapter and chapter 5, the second and third overarching research objectives are addressed. These objectives are:

1. To quantify and analyse monument condition change in eastern central Scotland since 1850.

2. To identify and evaluate the processes responsible for observed changes in monument condition.

In this chapter, rates and causes of monument loss since 1850 are examined. In addition, this chapter addresses one of the more specific research objectives outlined in section 2.3 by attempting to identify episodes of monument loss and the causes of any such episodes. Chapter 5 addresses more of the detailed research objectives outlined in section 2.3, through the examination of monument loss in relation to the environmental variables examined in chapter 3.

In the first instance, all quantification of monument loss has been based upon monument condition histories produced through the desk-based study, each based on NMRS records for each of the sample monuments. Due to biases in the information contained within the NMRS, however, it has been necessary to conduct an accuracy assessment of the monument loss information produced through the desk-based study. The results of this accuracy assessment have been used to calibrate the results of the desk-based study (section 4.3), while causes and dates of monument loss are identified and quantified in section 4.5.

It should be noted that the term 'monument loss' is used here to signify both monument damage and monument destruction. Where distinction between the two is required, specific reference is made. Before examining monument loss within the study area since 1850, however, it is necessary to examine the data on which this condition change assessment is based, in order to illustrate its shortcomings.

4.1 Monument condition change: data sources used

As described in section 2.5, all monument condition information used in the desk-based study has been based upon NMRS reports. However, There are limitations attached to the use of this data, as many of the sample monuments do not have written descriptions within the NMRS, while others have a number of dated descriptions.

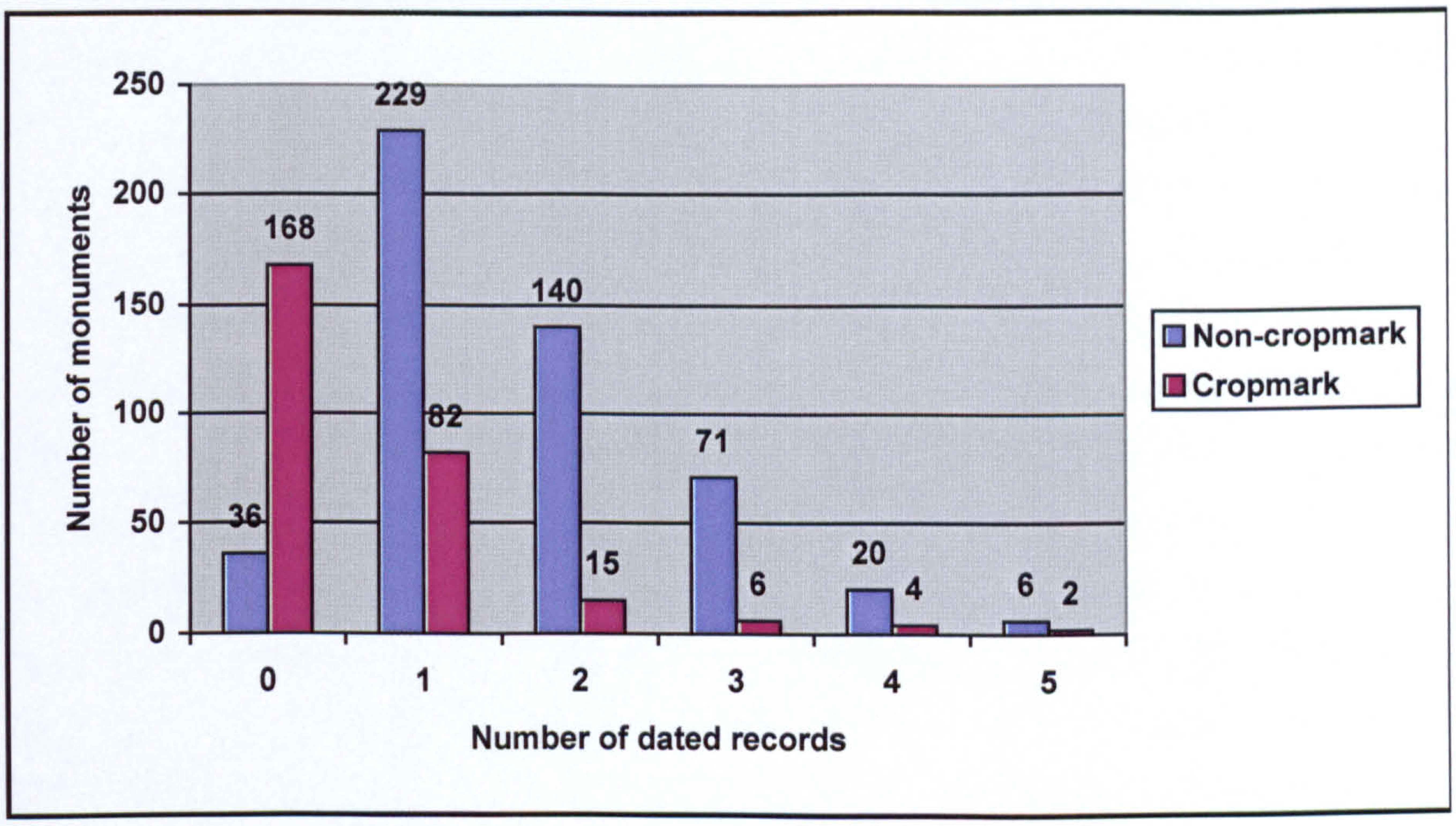

Figure 4.1. Numbers of dated NMRS descriptions among sample monuments.

Figure 4.1, which shows numbers of dated descriptions within the NMRS for cropmark and non-cropmark monuments, illustrates that the majority of cropmark monuments in the sample have no written description within the NMRS. By contrast, only 36 of 502 extant sample monuments have no written NMRS description, and nearly half are represented by two or more dated descriptions in the NMRS. As noted in chapter 3, the bulk of the sample monuments for which there is a long history of written record are stone-built prehistoric and medieval monuments situated at low altitudes. Consequently, it has not been difficult to construct condition histories for these monuments. For monument types such as cropmarks and MoLRS sites, however, written records are limited, and so condition histories have been more difficult to reconstruct. While analysis might have been most accurate if based only on those monuments with detailed recording histories, this would have meant excluding nearly all of the cropmarks and the majority of the MoLRS sites in the sample. However, in order to maintain consistency and ensure the inclusion of as many monument types as possible in this section of the desk-based study, the entire desk-based study sample of 779 monuments has been used to assess monument loss.

A number of measures have been taken to minimise any inaccuracies caused by the high level of assumption in assessing monument condition and condition change. Because of the varying degrees of condition information available from the NMRS on each of the monuments in the sample, it has been necessary to separate sample monuments into groups for analysis. In assessing condition change within the sample, four groups of monuments have been analysed. The first group comprises all 779 sample monuments, providing statistics on monument damage and loss for the entire sample. Because over a quarter of NMRS records for sample monuments contain no dated descriptions and a further 40% provide only one dated description, however, it has been necessary to eliminate monuments from analysis on the basis of the levels of information their NMRS records hold. Consequently, all monuments with one or more dated NMRS descriptions (575 monuments) have been analysed as a separate group, as have all those with two or more dated NMRS descriptions (264 monuments), and finally, all monuments with more than two dated NMRS descriptions (109 monuments). In separating the sample into groups in this manner, it has been possible to assess the extent to which analysis of the entire sample is likely to have been skewed by the lack of written information for some of the sample monuments.

The accuracy of monument condition data as interpreted from NMRS records has been assessed further, in a manner similar to the accuracy assessment and calibration of land use information in the census element of the desk-based study. Monument condition information as recorded through the desk-based study has been compared with condition information extracted from vertical and oblique aerial photographs, Historic Scotland Monument Warden reports, and from a programme of field survey undertaken over the winter of 2001 and spring of 2002. This has enabled an assessment of the accuracy of the monument condition information as recorded through the desk-based study. The methods by which monument condition histories have been constructed through the desk-based study have been described fully in section 2.5, but some points are worth re-iterating here.

Firstly, as noted above, the longer the history of written description of a monument in the NMRS, the easier it has been to reconstruct the monument's condition history. For monuments with no written description, there is no way of assessing condition change, and NMRS records with one dated description will not usually enable an assessment of condition change. Some exceptions occur, such as single dated descriptions including detail of recent damage or destruction. For example, if a cist is recorded in the process of destruction, then it has been safe to assume that its condition before discovery was better than its condition after discovery, and so a note of monument condition change has been made. Similarly, in the NMRS descriptions of some upland monuments recorded in the 1960s, direct reference is made to recent damage from forestry operations, so it has been safe to assume that condition change has taken place. Where NMRS records include two or more dated written descriptions, it has been relatively simple to detect changes in monument condition between the dates of each of the descriptions, though it should be emphasised that damage has been recorded only where it is demonstrable from the written reports that reduction has occurred. For example, if a monument is described in 1967 as being 'mutilated', but the monument condition is not noted in the 1928 report, no damage has been recorded, as it cannot be demonstrated from the report that the damage has occurred since 1928. The crucial factor in assessing condition change is that the wording of a dated description within the NMRS must be unequivocal in its identification of damage since the previous dated description. If condition change cannot be identified with any great confidence, then the monument's condition has been assumed to be unchanged. There has been a degree of subjectivity in assessing monument condition change in this manner, but all records have been assessed by the same person, and the same criteria have been applied throughout, minimising the potential for inconsistencies.

Secondly, the desk-based study has not assessed severity of damage or extent of damage at any given monument, even though it is recognised that the scale of damage noted may vary significantly between monuments. The cutting of a single field drain through one corner of a barrow, for example, is very different in nature and scale to the building of a housing estate over three quarters of a Roman temporary camp. However, given the subjective nature of the NMRS reports and the numbers of unknown quantities involved, scale of damage at any given monument has not been assessed at any stage of the desk-based study. Instead, monument condition has been classed as simply undamaged, reduced or destroyed since 1850.

Lastly, the desk-based study has assumed all monuments to be undamaged at 1850. This is not to say that all were in excellent condition in 1850, but treating each of the monuments in this manner provides a baseline against which all later monument condition can be compared. At 1850, many of the tower-houses were already ruinous, and it is inevitable that the field monuments will have been in varying states of preservation. However, as the NMRS contains a large number of subjective accounts, virtually none of which were compiled in order to assess monument condition, it has been impossible to assess actual monument condition at 1850. Therefore, all reference to condition presented in this chapter and chapter 5, whether undamaged, reduced or destroyed, is *relative to condition in 1850.*

4.2 Uncalibrated monument condition change: 1850 - 1999

As described in section 4.1, analysis of monument condition change has been undertaken for four groups of monuments, depending on the numbers of dated descriptions their NMRS entry contains. Firstly, all 779 sample monuments have been assessed as a single group.

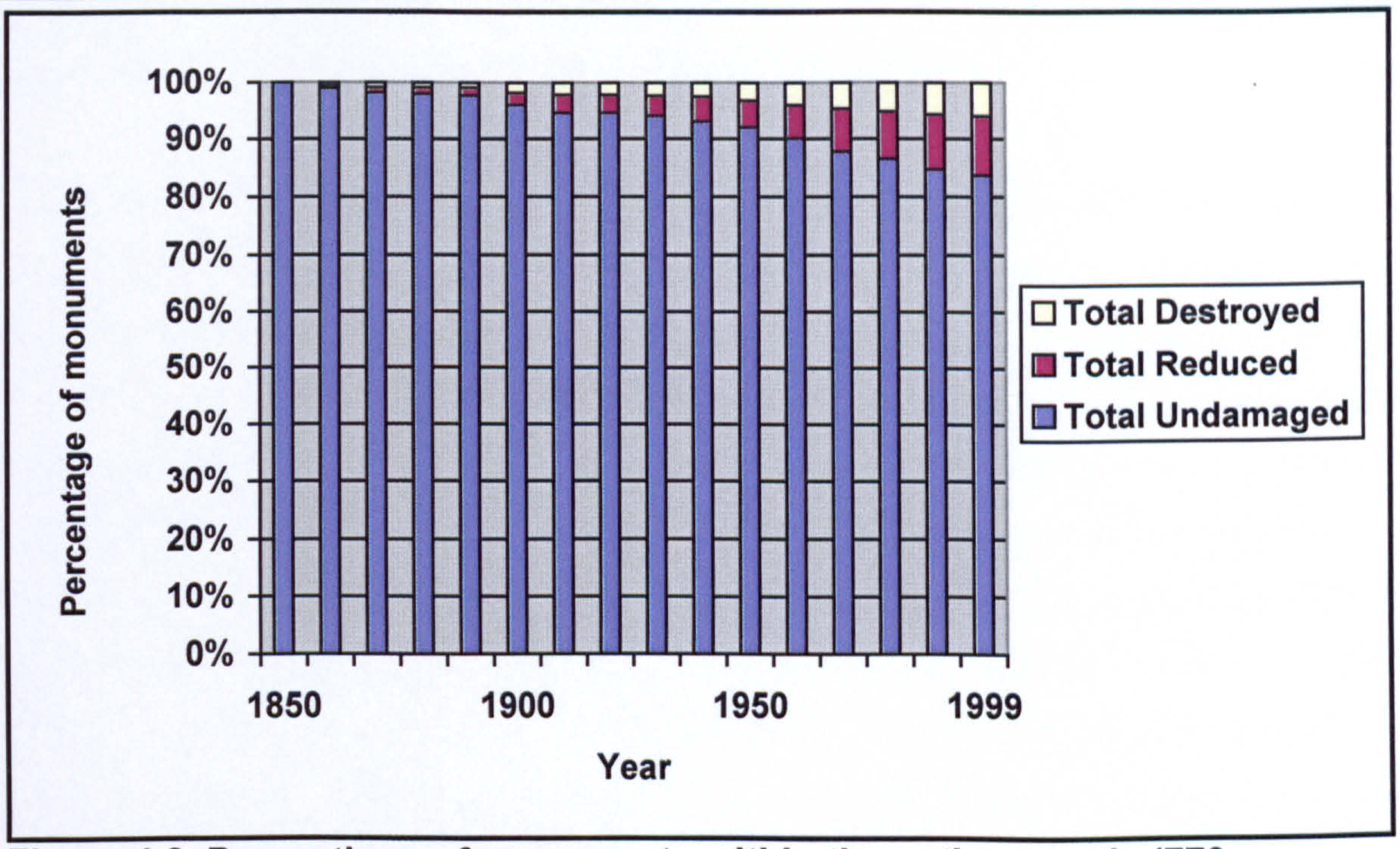

Figure 4.2. Proportions of monuments within the entire sample (779 monuments) undamaged, reduced and destroyed since 1850.

As figure 4.2 shows, about 10% of all sample monuments have been recorded through the desk-based study as being damaged and about 6% as destroyed between 1850 and 1999. Buried monuments in this group appear to survive better than extant monuments. According to the analysis based on all 779 sample monuments, only 82% of extant monuments are undamaged, while some 87% of buried monuments are undamaged. Within this group of buried monuments, however, there is a marked variation in rate of loss between cropmark and non-cropmark monuments. Among cropmarks (273 in total), about 95% are undamaged, while among non-cropmark buried features such as cists and souterrains (28 in total), only two (about 7%) are undamaged, with five (18%) reduced and 21 (75%) destroyed. The high level of destruction can be attributed to the mechanisms involved in the discovery of such buried features. Many buried monuments, particularly cists, are only noted during destruction. Because they are seldom recorded unless they are disturbed by invasive groundworks, very few non-cropmark buried features in the sample are recorded as undamaged. By contrast, the low levels of monument loss recorded at cropmark monuments can be attributed to the lack of written records of cropmarks included in the NMRS. The desk-based study has assumed that all monuments without written NMRS reports have remained unchanged in condition since 1850. It should be noted that four of the sample monuments were extant in 1850 but have since been reduced to cropmarks. Despite now being buried monuments, these are classed as 'extant, reduced' as the desk-based study records their condition relative to their 'starting' condition in 1850. Similarly, one monument, a buried cist exposed and left visible as an extant feature, is classed as 'buried, reduced' despite the fact that it is now extant.

Because the analysis of the figures produced using all 779 sample monuments assumes that damage has not occurred where it is not recorded in the NMRS, and many of the NMRS records used (particularly for cropmark monuments) contain no written information, it is likely that the results produced using all 779 monuments under-represent actual rates of monument loss. To reduce such inaccuracies, monuments without written NMRS reports have been removed from the sample for analysis, reducing the number of buried monuments from 301 to 133, and the number of extant monuments from 478 to 442, leaving a group of 575 monuments. Analysis based on this group of 575 monuments demonstrates greater levels of damage to sample monuments since 1850 than suggested by the analysis based on all 779 monuments.

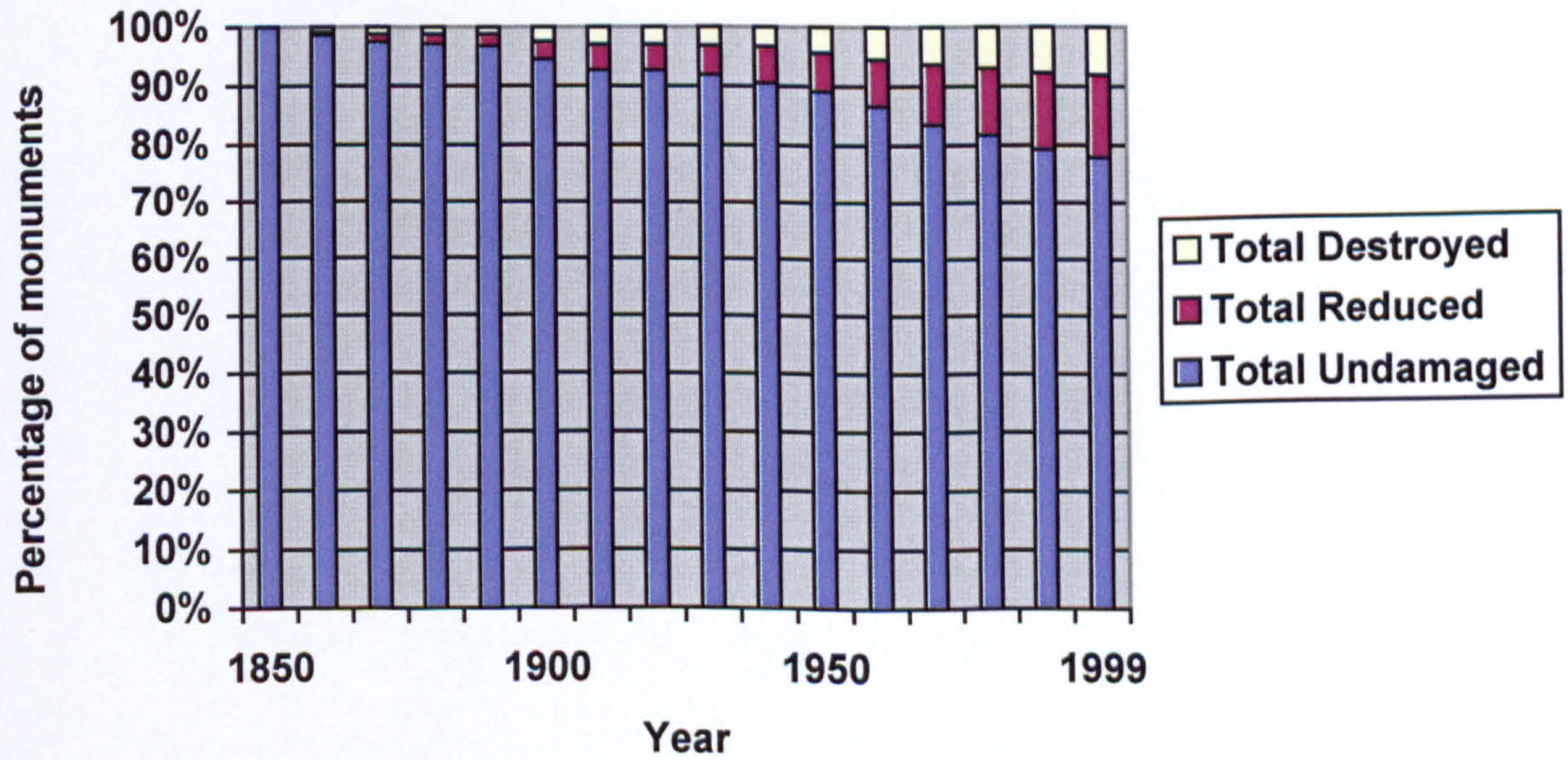

Figure 4.3. Proportions of monuments with one or more dated NMRS description (575 in total) undamaged, reduced and destroyed.

As figure 4.3 shows, analysis based on the sample of 575 monuments with a written NMRS report suggests that about 8% of monuments have been destroyed and 14% reduced in extent since 1850. Amongst extant monuments, about 5% are destroyed and about 15% are reduced, but within the group of 133 buried monuments, recorded destruction is much higher, with about 16% destroyed and about 13% reduced. Again, however, within this group of buried monuments, rates of loss vary between cropmark and non-cropmark monuments. Of the 105 cropmark monuments, only twelve (11%) are recorded as reduced, with a further one monument reduced (1%). Every case of reduction can be attributed to archaeological excavation, frequently in advance of development, while the single case of cropmark destruction has been through housing development. Of the 28 non-cropmark buried monuments, only two (7%) are recorded as undamaged, with five (18%) reduced and the remaining 21 (75%) destroyed.

Even with all monuments with no written NMRS description excluded from analysis, it remains likely that the rates of monument loss identified will be inaccurate. Nearly all extant monuments with only one dated NMRS description (213 in total) are assumed to be undamaged, and it is likely that as a result, the levels of loss identified among extant monuments since 1850 will be under-representative of actual rates of damage. In order to reduce further inaccuracies in the results of the desk-based study, a third stage of analysis has been undertaken, based only on monuments with two or more dated NMRS descriptions. With monuments for which there are fewer than two dated NMRS descriptions removed, the sample for analysis decreases to 264 monuments. Of these, 229 are extant monuments and 35 are buried (24 cropmark and eleven non-cropmark). As figure 4.4 shows, analysis suggests that only about 61% of monuments have remained undamaged since 1850, with about 27% reduced and 12% destroyed. Among extant monuments, only 64% have remained undamaged since 1850, with about 27% reduced and a further 9% destroyed. Of the 24 cropmarks in the sample, 16 (67%) are undamaged, seven (29%) are reduced, and one (4%) is destroyed. Of the 11 non-cropmark buried features, none are recorded as undamaged, with two (18%) reduced and nine (82%) destroyed. As cropmark and non-cropmark buried monuments with two or more dated NMRS descriptions number only 35, these figures emphasise again that most of the detailed written records for buried monuments within the NMRS exist only because the monument has been disturbed.

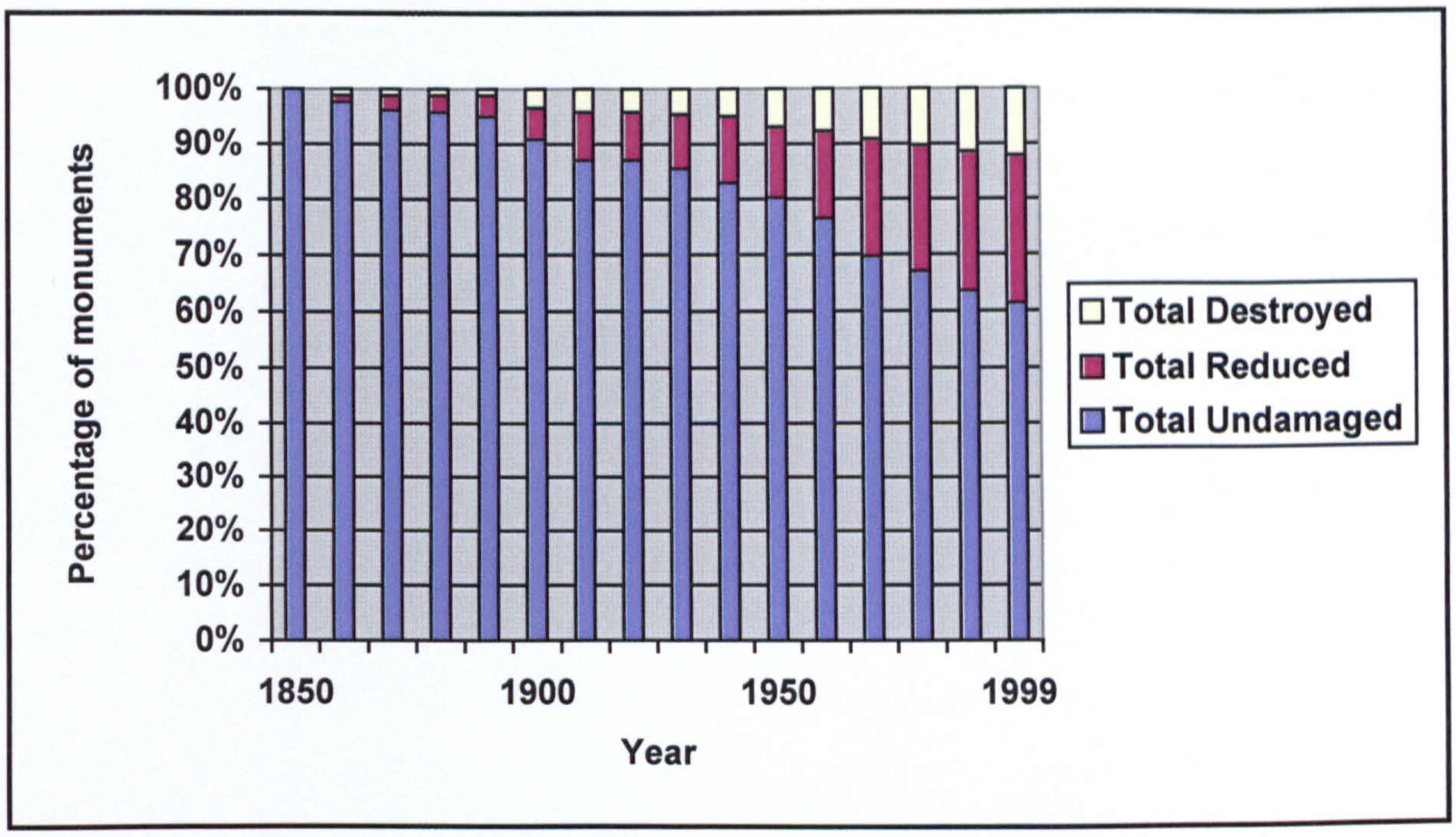

Figure 4.4. Proportions of monuments with two or more dated NMRS descriptions (264 in total) undamaged, reduced and destroyed.

The final stage of analysis has examined condition histories for all extant monuments with three or more NMRS descriptions, of which the sample contains 94. As figure 4.5 shows, the desk-based study records only 54% of these as undamaged up to 1999, with about 36% reduced in extent and 10% destroyed.

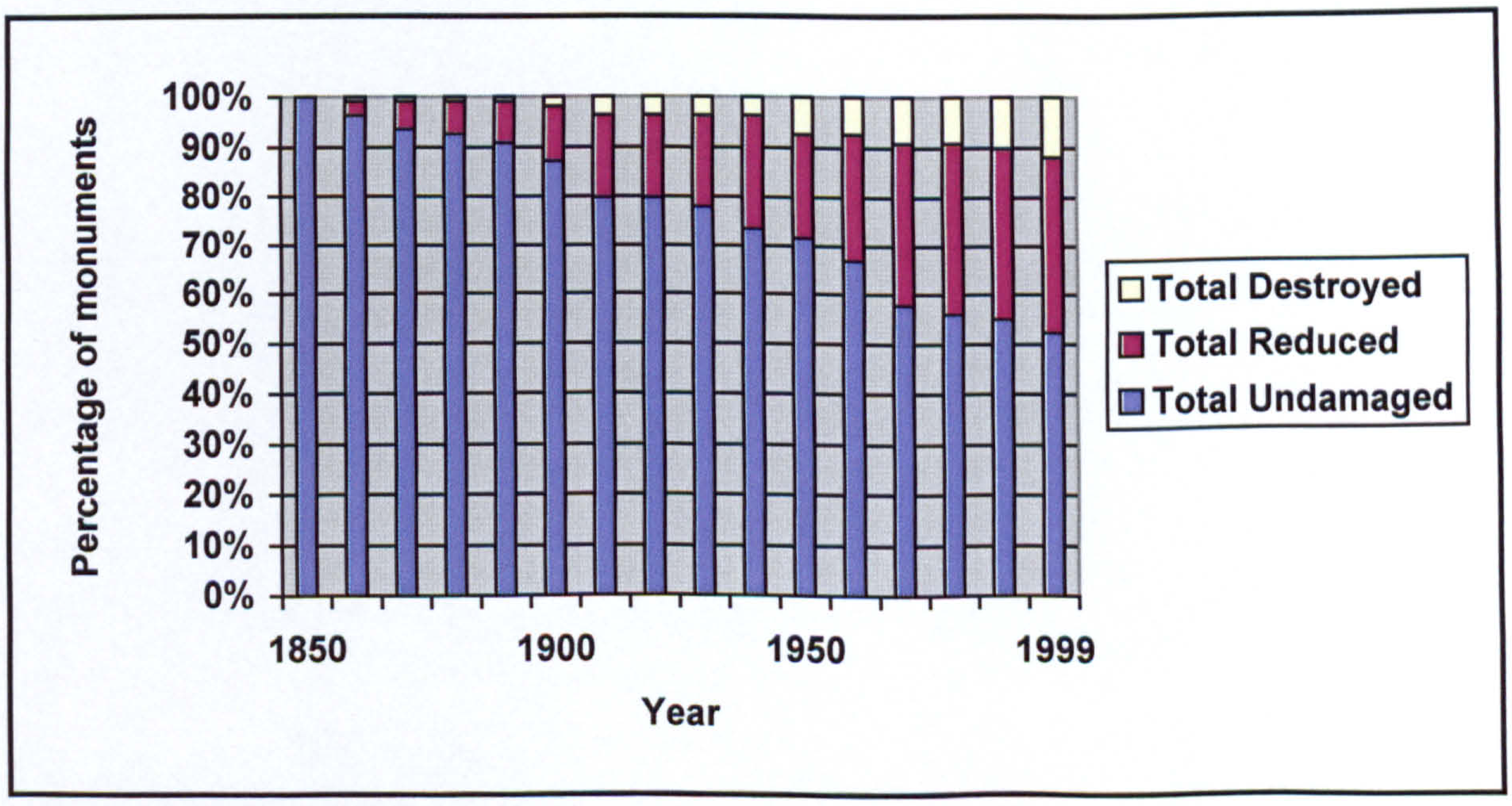

Figure 4.5. Proportions of extant monuments with three or more dated NMRS descriptions (109) undamaged, reduced and destroyed.

Worrying as these figures are, it could be argued that they are likely to more accurate than those produced for the groups of 779, 575 and 264 monuments respectively, as they are based upon the sample of monuments whose recorded histories contain the greatest detail. If these figures were indeed accurate, it would follow that those extant monuments with only one written description in the NMRS would have suffered similar rates of damage since 1850, but that this damage has simply not been recorded. However, this argument must be rejected for two reasons. Firstly, over half of the monuments with three or more dated NMRS descriptions are standing buildings or standing stones, as these monument types generally have the longest histories of recording within the desk-based study sample. In the case of standing buildings, condition will deteriorate unless the structures are maintained, and it is these 'status' monuments which have attracted most antiquarian excavation within the study area. Secondly, some of the monuments in this group only have several dated NMRS descriptions because they have been excavated on a number of occasions. This has created a bias in the population of monuments used for analysis, in that many of the monuments are recorded because they have been damaged through excavation.

4.2.1 Summary of uncalibrated monument condition change since 1850

Using the NMRS as a source of monument condition data has produced varied results, depending on levels of information contained within NMRS records. There are marked disparities in recorded monument condition change between buried and extant monuments, although these disparities are closely linked to the quantities of condition data available for the monuments in question. Condition change can be best detected where a monument is represented in the NMRS by at least two written descriptions. The majority of such monuments are extant. Among buried monuments, however, most cropmarks have no written description in the NMRS, while buried features such as cists are seldom recorded unless in the course of damage or destruction.

Number of dated NMRS descriptions	Number of extant monuments	Percentage undamaged	Percentage reduced	Percentage destroyed
0	36	100	0	0
1	213	97.5	1.4	0.9
2	135	70.4	20.0	9.6
> 2	94	54.2	36.2	9.6
All monuments	478	81.6	13.4	5.0

Table 4.1. Proportions of monuments extant at 1850 by current condition.

Table 4.1, which summarises damage to extant monuments according to numbers of dated NMRS descriptions, shows that among extant monuments with one or no dated NMRS description, very little damage is recorded. Among monuments with two dated NMRS descriptions, however, the total of undamaged monuments drops to 70%, and among monuments with over two dated NMRS descriptions the total of undamaged monuments drops to about 54%. It is worth noting that although recorded reduction rises with numbers of dated NMRS descriptions, the proportion of monuments destroyed remains constant at about 10%.

Number of dated NMRS descriptions	Number of cropmark monuments	Percentage undamaged	Percentage reduced	Percentage destroyed
0	168	100	0	0
1	81	93.8	6.2	0
2	13	76.9	15.4	7.7
> 2	11	54.6	45.4	0
All monuments	273	95	4.6	0.4

Table 4.2. Proportions of cropmark monuments by current condition.

As table 4.2, which summarises damage to cropmark monuments according to numbers of dated NMRS descriptions, shows, the majority of NMRS records for cropmarks contain no written description. Because of this, only a small overall proportion (5%) of cropmark monuments are recorded as reduced or destroyed. Among those cropmark monuments with one or more written description, however, damage levels recorded are not dissimilar to those of extant monuments.

Number of dated NMRS descriptions	Number of non-cropmark buried monuments	Percentage undamaged	Percentage reduced	Percentage destroyed
0	0	0	0	0
1	17	11.8	17.7	70.6
2	7	0	28.8	71.4
> 2	4	0	0	100
All monuments	28	7.1	17.9	75

Table 4.3. Proportion of non-cropmark buried monuments by current condition.

As noted previously, with the exception of two monuments, all non-cropmark buried monuments in the sample used for the desk-based study are recorded as either reduced or destroyed. As table 4.3 illustrates, most of these has been recorded only once, presumably during their disturbance.

Taking into account the likely biases in the results produced using each of the groups of monuments analysed, it is not possible to produce definitive totals of monuments undamaged, reduced or destroyed. It is possible, however, to outline worst- and best-case scenarios, and to estimate likely levels of monument loss. As the desk-based study has assumed that a monument has remained undamaged since 1850 unless damage can be identified from the NMRS record, analysis of condition data for all 779 of the sample monuments provides best-case scenario results, and suggests that some 84% of sample monuments (82% of extant, 95% of cropmark, 7% of non-cropmark buried) have remained undamaged since 1850. According to this best-case scenario, overall, about 10% of sample monuments have been reduced, and about 6% destroyed since 1850. By contrast, a worst-case (but perhaps not unrealistic) scenario for extant monuments can be portrayed by using only the 228 extant monuments with two or more dated NMRS descriptions as a basis for analysis. Results produced using these monuments suggest that only about 63% of extant monuments remain undamaged since 1850, with about 27% reduced and 10% destroyed.

Among cropmark monuments, the majority have no dated NMRS description. The worst-case scenario proposed for cropmark monuments is based upon the 105 with one or more dated NMRS description. Using only these monuments as a basis for analysis suggests that about 87% are undamaged since 1850, with about 12% reduced and 1% destroyed. Among non-cropmark buried monuments, the best-case scenario suggests that only about 7% remain undamaged since 1850. It is impossible to assess the accuracy of this figure, and to suggest a worst-case scenario would be futile, for two reasons. Firstly, it is impossible to quantify numbers of undamaged non-cropmark buried features accurately, as they are largely unrecorded. Secondly, it is likely that non-cropmark buried features like cists will have been damaged or destroyed by agriculture and development since 1850, but that no record has been made of their discovery or destruction. Because of the likely presence of considerable numbers of unrecorded non-cropmark buried features, the best-case scenario of 93% damaged or destroyed is an over-exaggeration. In assessing condition change to non-cropmark buried monuments, it is possible to suggest that a minimum of 7% of *recorded* buried features within the study area have remained undamaged since 1850, but the actual proportion of undamaged buried monuments is likely to be significantly higher.

Among cropmark monuments, it is highly probable that damage levels recorded through the desk-based study are inaccurate also, as agricultural damage is virtually impossible to record without excavation. All damage to cropmark monuments in the desk-based study is of elements lost through development or excavation. The *Management of Archaeological Sites in the Arable Landscape* project (Oxford Archaeology 2002) suggests that ongoing agricultural damage is likely to occur at many cropmark monuments, yet there is no example within the desk-based study of agricultural damage being recorded at a cropmark monument. In contrast to the monument loss statistics produced for non-cropmark buried monuments, it is inevitable that the worst-case scenario of 13% of cropmarks damaged or destroyed is an significant under-representation of actual damage since 1850. In assessing condition change to cropmark monuments, it is possible to suggest that a maximum of 95% of cropmarks within the study area have remained undamaged since 1850 (the best-case scenario), but the actual proportion of undamaged buried monuments is likely to be significantly lower. It must be emphasised that these figures are based upon monument condition information obtained through interpretation of NMRS records. Given the many unknown quantities involved in the assessment of damage to buried features (particularly cropmarks), it must be concluded that a desk-based study is not an adequate means of quantifying loss of buried monuments.

4.3 Calibration of monument condition change

While examination of figures produced using the NMRS as a condition data source provides an indication of identified monument loss within the study area since 1850, it must be remembered that very little of the information on monument condition contained in the NMRS has been recorded systematically. Rather, such information has found its way into the NMRS as much by good fortune as by any other means. As shown in chapter 3, the data on which the desk-based study has been based is subject to various biases in recording and identification. In addition, through the course of the desk-based study, where no damage has been positively identified from the NMRS entry, monument condition has been assumed to be unchanged since 1850. It is highly likely, therefore, that the results of the desk-based study alone provide an under-representation of actual levels of extant and cropmark monument loss within the study area.

In order to assess the accuracy of the monument condition information produced through the desk-based study, an accuracy assessment has been carried out, during which detailed condition information has been collected for a sub-sample of 258 monuments. As with the land use calibration exercise carried out as part of the census, some methods of checking the accuracy of monument condition information have proved more successful than others.

Method of checking used in accuracy assessment	Number and percentage of monuments recorded as undamaged by desk-based study		Number and percentage of monuments recorded as reduced by desk-based study		TOTAL
	Number	Percent	Number	Percent	
Vertical Aerial Photograph	36	52.2	33	47.8	69
Oblique Aerial Photograph	60	84.5	11	15.5	71
Field Survey	49	80.3	12	19.7	61
Monument Warden Survey	48	84.2	9	15.8	57
TOTAL / AVERAGE	193	74.8	65	25.2	258

Table 4.4. Numbers of monuments included in the accuracy assessment according to the method used to check condition.

Table 4.4 shows numbers of monuments included in the accuracy assessment according to the method by which they have been checked, and shows that nearly half of those monuments checked using vertical aerial photographs are recorded as reduced by the desk-based study, compared with about 17% of monuments checked using oblique aerial photographs, Monument Warden reports and field survey. This is because many monuments for which no date or cause of damage could be determined through the desk-based study were checked using vertical aerial photographs anyway, and an accuracy assessment of the condition of these monuments was carried out at the same time. As a result, 25% of monuments checked during the accuracy assessment are already recorded as reduced by the desk-based study, compared with the 10% reduced suggested by the uncalibrated desk-based study figures for all 779 sample monuments. It could be argued that unrecorded damage is more likely to have occurred where recorded damage is present, and that monuments which are recorded as undamaged by the desk-based study are less likely to have been subject to unrecorded damage. It is possible, therefore, that rates of monument loss recorded through the accuracy assessment might be over-representative of actual monument loss rates.

Monument condition according to desk-based study	Number of monuments included in accuracy assessment	Number of damage events identified by desk-based study	Number of 'new' damage events recorded by accuracy assessment	Number of 'new' damage events recorded by accuracy assessment per number of monuments examined
Undamaged	193	0	43	0.22
Reduced	65	90	15	0.23
Total / Average	258	90	58	0.22

Table 4.5. Rates of 'new' damage recorded through the accuracy assessment.

As table 4.5 demonstrates, at the 193 monuments checked for which no damage has been recorded through the desk-based study, 43 'new' damage cases have been recorded through the accuracy assessment. This equates to 0.22 new damage cases per monument checked. At the 65 monuments checked for which damage has been recorded through the desk-based study, 15 'new' damage cases have been recorded through the accuracy assessment, equating to 0.23 new damage cases per monument checked. This suggests that overall rates of new damage recorded through the accuracy assessment are not related to the presence of damage already recorded through the desk-based study. However, the rate of 'new' damage cases recorded through the accuracy assessment is slightly higher at monuments recorded as damaged through the desk-based study when the accuracy assessment has been carried out using Monument Warden reports or field survey. As table 4.6 shows, the 'new' damage rate at monuments checked using Monument Warden reports is 0.33 per monument recorded as undamaged through the desk-based study and 0.44 per monument recorded as reduced by the desk-based study. A similar pattern exists for monuments checked using field survey, suggesting that monuments already recorded as reduced through the desk-based study may indeed be more likely to have been subject to unrecorded damage. Because of this possible bias in the data used in the accuracy assessment, the results of the accuracy assessment should be treated as indicative rather than definitive.

Method of checking according to monument condition as recorded by the desk-based study		Number of monuments checked	Number of 'new' damage events recorded through accuracy assessment	Number of 'new' damage events identified per monument checked during accuracy assessment
Monuments recorded as undamaged through the desk-based study	Vertical A.P.s	36	7	0.19
	Oblique A.P.s	60	1	0.02
	Field Survey	49	19	0.39
	Monument Warden reports	48	16	0.33
	Total / Average	**193**	**43**	**0.22**
Monuments recorded as reduced through the desk-based study	Vertical A.P.s	33	6	0.18
	Oblique A.P.s	11	0	0
	Field Survey	12	5	0.42
	Monument Warden reports	9	4	0.44
	Total / Average	**65**	**15**	**0.23**
Grand Total / Average		**258**	**58**	**0.22**

Table 4.6. Rates of 'new' damage recorded through the accuracy assessment according to the checking method used.

Of the 258 monuments checked through the accuracy assessment, 68 have been checked using vertical aerial photographs only, 50 using Historic Scotland Monument Warden reports and photographs, and 61 through a programme of field survey. In addition, 79 cropmark monuments have been checked using existing oblique aerial photographs and Historic Scotland Monument Warden reports. Each method has provided a varying degree of success in validating monument condition as noted through the desk-based study. It should be noted that as stated in section 2.5, damage has been recorded during the accuracy assessment *only* where it can be demonstrated that this damage has occurred since 1850 *and* is damage that has not been recorded by the desk-based study. Where any doubt has existed, damage has not been recorded.

In the following sections of the chapter (4.3 and 4.4), the results of the accuracy assessment and calibration of the results of the desk-based study are described. First, the accuracy assessment results and calibration are described for extant monuments according to data retrieved using all three of the validation methods (vertical aerial photographs, Historic Scotland Monument Warden reports and field survey). Secondly, accuracy assessment results according to each validation method are described separately, in order to illustrate variations in the results of the accuracy assessment depending on which validation source is used. Finally, accuracy assessment results relating to cropmark monuments (produced using oblique aerial photographs and Historic Scotland Monument Warden reports) are discussed. Because most of the non-cropmark buried features in the sample are destroyed and most undamaged buried features are unrecorded, no attempt has been made to assess the accuracy of the desk-based study in identifying condition change at non-cropmark buried monuments.

4.3.1 <u>Using the accuracy assessment to calibrate monument condition change</u>

The method used in the accuracy assessment has been a straightforward comparison between the condition of a monument as recorded by the desk-based study and the condition of the same monument as recorded using the data sources described above. Where demonstrable loss has occurred which has not been recorded through the desk-based study, this has been noted. The process of calibration is outlined here, using the desk-based study results for extant monuments to illustrate.

1. Counts have been made of the 258 monuments checked during the accuracy assessment, according to their condition as noted by the desk-based study. These counts have then been converted into percentages within each monument type group (extant, buried, all monuments), as shown in table 4.7 (extant monuments only).

	Extant, undamaged	Extant, reduced	Extant to destroyed	Total
Number of extant monuments in calibration	125	55	0	180
Percentage of extant monuments in calibration (of 258 monuments)	**48.45**	**21.32**	**0**	**69.77**

Table 4.7. Extant monuments used for calibration according to their condition as recorded through the desk-based study.

2. Counts have been made of the same 258 monuments, according to their condition as noted during the accuracy assessment. Again, these counts have then been converted into percentages within each monument type group (extant, buried, all monuments), as shown in table 4.8.

	Extant, undamaged	Extant, reduced	Extant to destroyed	Total
Number of extant monuments in calibration	95	84	1	180
Percentage of extant monuments in calibration (of 258 monuments)	**36.82**	**32.56**	**0.39**	**69.77**

Table 4.8. Extant monuments used for calibration according to their condition as recorded through the accuracy assessment.

3. The difference in percentage between expected and observed percentages within each monument type group has been noted, as shown in table 4.9.

	Extant, undamaged	Extant, reduced	Extant to destroyed	Total
Percentage of extant monuments by condition category, according to desk-based study (e)	48.45	21.32	0	69.77
Percentage of extant monuments by condition category, according to accuracy assessment (o)	36.82	32.56	0.39	69.77
Observed percentage (o) minus expected percentage (e)	**- 11.63**	**11.24**	**0.39**	**0**

Table 4.9. Extant monuments used for calibration according to their condition as recorded through the desk-based study.

4. A calibrated total of monuments in each condition category has then been produced using the following formula:

$$C = \frac{d + (o - e)}{100} \times 779$$

Where: C = calibrated total of monuments in condition category

d = percentage of monuments in condition category as recorded by desk-based study

e = percentage of monuments in condition category, as recorded through desk-based study

o = observed percentage of monuments in condition category during accuracy assessment.

The manner in which this formula has been applied to calibrate the results of the desk-based study using the results of the accuracy assessment is demonstrated in table 4.10 (overleaf).

	Extant, undamaged	Extant, reduced	Extant to destroyed	Total
Number of monuments in condition category as recorded by desk-based study	390	64	24	478
Percentage (of 478 extant monuments) in condition category as recorded by desk-based study	81.59	13.39	5.02	100
Percentage (of **779** monuments) in condition category as recorded by desk-based study (d)	50.06	8.21	3.08	61.35
Observed percentage of monuments in condition category (of 258 monuments) during accuracy assessment (o)	36.82	32.56	0.39	69.77
Percentage of monuments included in accuracy assessment (of 258), shown by condition as recorded through desk-based study (e)	48.45	21.32	0	69.77
o – e	- 11.63	11.24	0.39	0
d + (o - e), divided by 100	0.3843	0.1945	0.0347	0.6135
d + (o - e), divided by 100, multiplied by 779 = Calibrated total	**299**	**155**	**27**	**478**

Table 4.10. The calibration process, illustrated using statistics from the desk-based study and accuracy assessment for all extant monuments.

As tables 4.7 and 4.8 have shown, the condition of 180 monuments recorded as extant by the desk-based study has been examined using vertical aerial photographs, Historic Scotland Monument Warden reports and field survey. Of these 180 monuments, the accuracy assessment has shown 30 to have been subject to damage not recorded through the desk-based study, and one to have been destroyed. By comparing these observed and expected proportions of monuments undamaged, reduced and destroyed (as shown in rows 4, 5 and 6 of table 4.10), it is possible to suggest that the actual proportion of monuments undamaged will be 11.63% lower than suggested by the desk-based study, while the proportion of damaged monuments will be 11.24% higher. Correspondingly, the proportion of monuments destroyed will be 0.39% higher than suggested by the desk-based study. The uncalibrated results of the desk-based study suggest that as a best-case scenario, about 82% of extant sample monuments have remained undamaged since 1850, with 13% reduced and 5% destroyed. By calibrating these results as shown in rows 7 and 8 of table 4.10, it is possible to suggest that only about 63% of extant monuments remain undamaged since 1850, with 31% damaged and about 6% destroyed.

These figures remain largely unchanged when monuments with no dated NMRS descriptions are excluded from analysis. With such monuments removed, the number of extant monuments checked drops to 172 (of 442 included in the desk-based study). During the accuracy assessment, damage has been recorded at about 25% of these 172 extant monuments recorded by the desk-based study as undamaged. Calibration of the condition figures produced through the desk-based study (80% undamaged, 15% reduced and 5% destroyed) based on the accuracy assessment suggests that about 62% of extant monuments are undamaged since 1850, with 32% reduced and 6% destroyed.

Taking the accuracy assessment and calibration a stage further by removing all monuments with fewer than two dated NMRS descriptions produces similar patterns to the analysis based on all extant monuments and monuments with one or more dated descriptions. The results of the accuracy assessment show that only about 81% of extant monuments recorded as 'undamaged' through the desk-based study are undamaged, with the accuracy assessment recording damage at 12 of 64 such monuments. The worst-case scenario provided by the desk-based study for extant monuments uses only the 228 extant monuments with two or more dated NMRS descriptions as a basis for analysis. The desk-based study results produced using these monuments suggest that only about 63% of extant monuments remain undamaged since 1850, with about 27% reduced and 10% destroyed. Calibration of these figures on the basis of the accuracy assessment suggests that final percentages of extant monuments are approximately 48% undamaged, 31% reduced and 11% destroyed. The calibrated results of the desk-based study for extant monuments according to numbers of dated NMRS descriptions per monument are shown in figure 4.6.

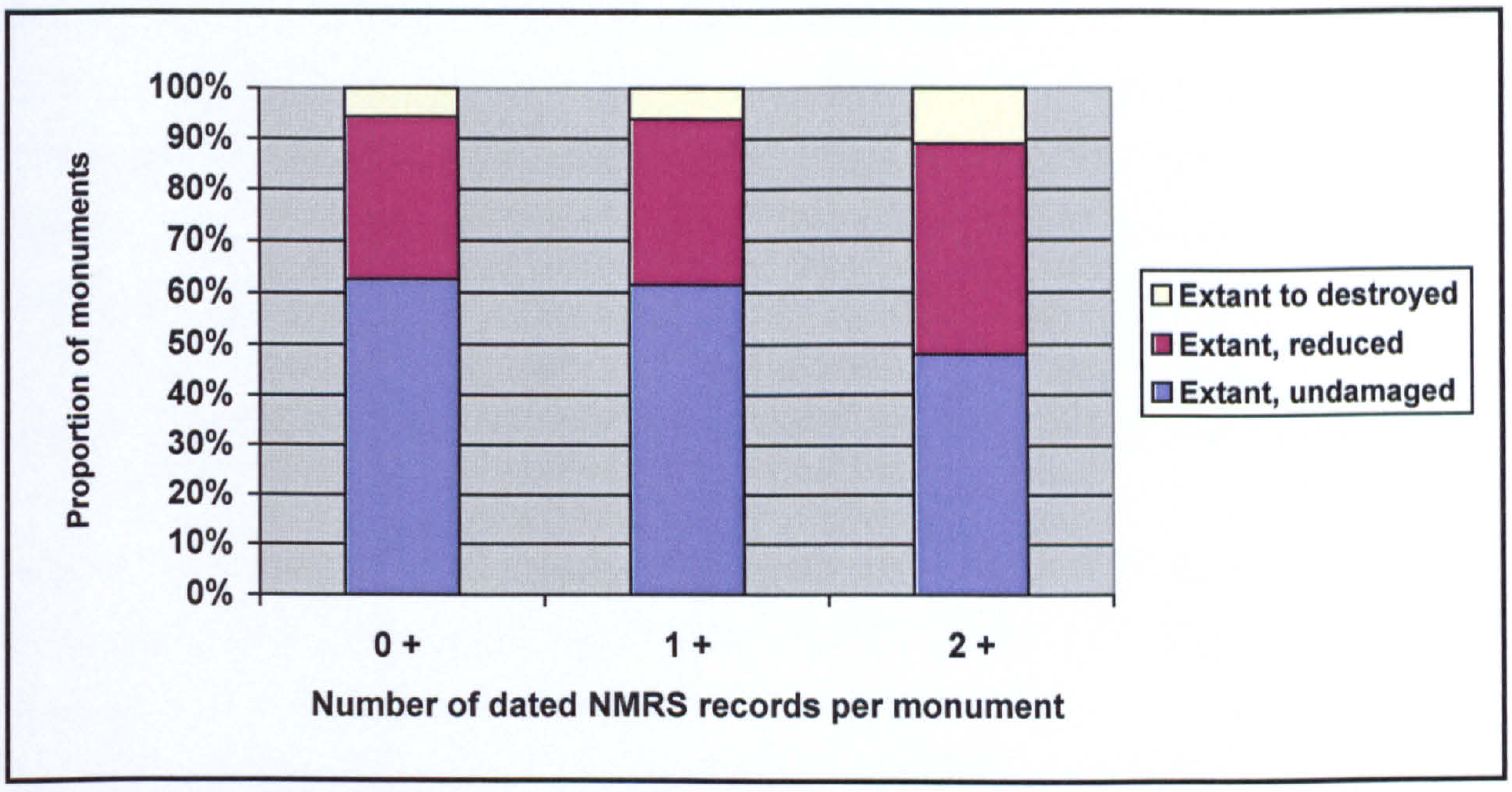

Figure 4.6. Calibrated proportions of extant monuments undamaged, reduced and destroyed according to numbers of dated NMRS descriptions per monument

In summary, calibration of the results of the desk-based study based on the results of the accuracy assessment suggests that at best, only about 62% of extant sample monuments have remained undamaged within the study area since 1850. Calibration based on monuments with two or more dated NMRS descriptions suggests that at worst, only about 48% of extant sample monuments have remained undamaged since 1850. All three methods of verifying monument condition during the accuracy assessment (aerial photographs, Historic Scotland Monument Warden reports and field survey) have been used to produced these calibrated figures. However, each of these methods has provided a differing degree of success in validating monument condition, and by breaking the results of the accuracy assessment into three groups according to the method by which condition validation has been achieved, it has been possible to assess which of the validation methods has provided the most accurate results.

4.3.2 Condition calibration using vertical aerial photographs

There are 68 extant monuments for which vertical aerial photographs have been used to check condition. Of these 68, the accuracy assessment has identified damage at three (9%) which was not noted in the desk-based study, with a further one monument destroyed. A further two have probably suffered damage, but it has not been possible to confirm this on the basis of the aerial photographs alone, and so these have been treated as undamaged. Calibration of the best-case scenario figures produced through the desk-based study using the evidence of vertical aerial photographs suggests that about 77% of extant sample monuments remain undamaged, with about 16% reduced and 7% destroyed since 1850. These figures indicate lower rates of damage than presented through calibration using all three modes of checking monument condition, but also indicate higher rates of monument destruction, though this is on the basis of a single case of destruction recorded through the accuracy assessment.

4.3.3 Condition calibration using Historic Scotland Monument Warden Reports

Historic Scotland Monument Warden reports for 50 extant scheduled sample monuments have been examined. These date from 1987 to 2000, and most monuments have a series of dated Monument Warden reports, enabling condition change to be identified between report dates. Of the 50 monuments checked, the Monument Warden reports indicate that at least 12 have experienced damage or reduction not recorded through the desk-based study. Using these figures to calibrate the best-case scenario results produced by the desk-based study suggests that only about 57% of extant sample monuments have remained undamaged since 1850, 38% have been reduced and about 5% have been destroyed.

4.3.4 Condition calibration using field survey

Field survey has shown that 15 of the 61 monuments surveyed have been subject to damage not detected through the desk-based study. When used to calibrate damage recorded through the desk-based study, these results suggest that in keeping with the calibration figures produced through the use of Monument Warden reports, about 57% of extant sample monuments have remained undamaged since 1850, with about 38% reduced and about 5% destroyed.

4.3.5 Calibration of condition figures for cropmark monuments

While assessment of the accuracy of the desk-based study in identifying monument condition change shows that damage to extant monuments is under-represented within the desk-based study, the actual condition of buried monuments is very difficult to ascertain. Non-cropmark negative features such as cists and souterrains are seldom recorded except where damage or destruction has occurred. By contrast, agricultural damage to cropmarks is virtually impossible to record without excavation. As a result, the statistics produced by the desk-based study relating to the condition of buried monuments (both cropmark and non-cropmark) are difficult to verify. Because most non-cropmark buried monuments recorded are now destroyed, the accuracy of the desk-based study in assessing the condition of cropmark sites only has been assessed. Checks have been made for 79 cropmark monuments using oblique aerial photographs and Monument Warden reports to assess the accuracy of the desk-based study in identifying *visible* damage, such the removal of cropmarks or parts of cropmarks through development or excavation. Of the 79 monuments examined, only three demonstrate damage not detected through the desk-based study. Calibration of the best-case scenario figures produced through the desk-based study suggests that about 90% of cropmark monuments are undamaged since 1850, with 9.5% damaged and about 0.5% destroyed. It must be emphasised, however, that these figures refer only to visible damage such as excavation and development noted in the NMRS, and that unrecorded agricultural damage, though probably extensive, has not been included.

4.4 The accuracy assessment and calibration: summary and conclusions

By assessing the accuracy of the desk-based study in identifying change in monument condition, it has been possible to calibrate the results of the desk-based study, providing greater accuracy in quantifying monument condition change within the study area since 1850. In calibrating the totals of extant monuments undamaged, reduced and destroyed, the most effective method of identifying actual monument condition has been to visit the monument or to consult Historic Scotland Monument Warden reports, all of which date to within the last 16 years. Although vertical aerial photographs have been used successfully to identify previously unrecorded condition change at a few extant monuments, the amount of damage recorded by this means has fallen significantly short of the damage identified through field survey and Monument Warden reports. This is well illustrated by the fact that vertical aerial photographs dating from about 1946 to 1988 were obtained for each of the 61 surveyed monuments prior to survey taking place, but of the 15 monuments surveyed with previously unrecorded damage, this damage could be identified from the aerial photographs at only three monuments. In two cases, damage had occurred through a land use change to forestry, and in the third case, a track had been constructed, removing parts of a monument. This demonstrates further that as a method of checking extant monument condition change, aerial photographs have provided substantially less information than field survey, as they tend to show only damage which has resulted from a large-scale event such as land use change or development.

Assessing the accuracy of the desk-based study in identifying condition change at cropmark monuments has been less successful, and consequently, calibration of the damage figures produced by the desk-based study has been limited. Ongoing agricultural damage to buried features is seldom possible to identify, and so the calibration exercise, like the desk-based study itself, has involved the identification of visible damage only, on the basis of oblique aerial photographs and Historic Scotland Monument Warden reports.

As the field survey and Monument Warden reports have proved most productive as sources against which to check monument condition, final calibration of condition statistics presented here is based upon the accuracy assessment using these two sources and discounting the assessment made using vertical aerial photographs. Calibration of the results of the desk-based study, using accuracy assessment results produced through the use of Monument Warden reports and field survey combined, suggests that *as a best-case scenario,* approximately 56% of recorded extant monuments remain undamaged since 1850, with about 39% reduced and 5% destroyed, as shown in table 4.11.

		Number of monuments	Undamaged (%)	Reduced (%)	Destroyed (%)	Total (%)
Results based on all extant monuments	Uncalibrated	478	82	13	5	100
	Calibrated	478	57	38	5	100
Results based on extant monuments with 1 or more NMRS description	Uncalibrated	442	80	15	5	100
	Calibrated	442	57	38	5	100
Results based on extant monuments with 2 or more NMRS descriptions	Uncalibrated	229	63	27	10	100
	Calibrated	229	47	43	10	100

Table 4.11. Proportions of extant sample monuments undamaged, reduced and destroyed when calibration is based only on field survey and Monument Warden reports.

As table 4.11 shows, the results produced by the desk-based study alone are significantly under-representative of damage to extant monuments, although calibration has had little effect on the proportion of monuments recorded as destroyed. The number of monuments recorded as destroyed after calibration is surprisingly low, given the marked increase in recorded damage to monuments suggested after calibration. Of the 258 monuments checked as part of the accuracy assessment, only one was found (through the use of vertical aerial photographs) to have been destroyed. Of the monuments checked using field survey and Historic Scotland Monument Warden reports, none were found to be destroyed. Among scheduled monuments, this is unsurprising, given the statutory protection they are afforded. Of the unscheduled monuments checked through field survey, although none were found to be destroyed, at least five of the 61 monuments surveyed were reduced to such an extent that they were almost destroyed. In some cases, were it not for the use of a hand-held GPS, it is likely that some monuments would not have been located at all.

It is possible that levels of monument destruction since 1850 have been higher than suggested by the desk-based study, but that much of this destruction has occurred to monuments which were never recorded. The number of monuments destroyed without being recorded is impossible to quantify, and estimating the numbers of such monuments would be pointless and potentially misleading. In any case, this figure would be offset against the number of undamaged monuments in the study area which have yet to be recorded. Again, however, this figure is impossible to quantify. It is only possible to conclude, therefore, that at best, about 57% of recorded extant monuments remain undamaged since 1850, with about 38% reduced and 5% destroyed. The calibrated results of the desk-based study suggest that among recorded cropmark monuments, fewer than 1% have been destroyed, with about 9% reduced about 90% undamaged.

4.5 Causes of monument loss

Although quantification of sample monument condition change shows that significant numbers have been damaged or destroyed since 1850, it is important to recognise the processes responsible for this monument loss. For each of the 779 desk-based study monuments and 258 monuments used in the condition accuracy assessment, causes and dates of damage have been recorded. As with the quantification of monument loss, however, it is necessary to review the nature of the data on which damage identification has been based in order to identify its limitations. Though the desk-based study has recorded 127 monuments as reduced or destroyed (uncalibrated), as some monuments have been subject to more than one case of damage, a total of 167 damage and destruction cases have been identified. All of these have been identified initially from the NMRS, but vertical and oblique aerial photographs have also been checked where the precise cause or date of damage has not been clear from the NMRS reports alone. Even with checks using aerial photographs, it has not been possible to establish precise dates or causes of all damage cases identified. Furthermore, as previous sections of this chapter have shown, monuments with a long history of recording are more likely to have damage noted in the NMRS than monuments with a short history of recording, leading to potential biases in the recording of damage towards some classes of monument, such as 'status' stone-built monuments.

For the reasons outlined above, and because some sample monuments have been subject to more than one case of damage, it has been necessary to limit the extent and scope of analysis of damage types. Throughout this chapter, all damage cases are treated as being from the entire desk-based study sample of 779 monuments, irrespective of the levels of NMRS data on the monuments where the damage has occurred. Damage cases have been noted and quantified where possible, but this analysis can be treated as indicative only. No attempt has been made to calibrate levels of damage or destruction by damage type, but the results of the accuracy assessment (which are presented throughout the remainder of this chapter and chapter 5) provide an indication of damage types which may be under-represented in the results of the desk-based study.

4.5.1 General causes and dates of loss identified through the desk-based study

A total of 167 damage cases have been identified through the desk-based study at the 127 monuments recorded as reduced or destroyed. Of the 127 damaged monuments, 30 have been subject to two cases of damage, nine have been subject to three damage cases, and one unfortunate monument has been affected by four damage episodes recorded through the desk-based study. The frequencies of various damage causes identified through the desk-based study are summarised in figure 4.7.

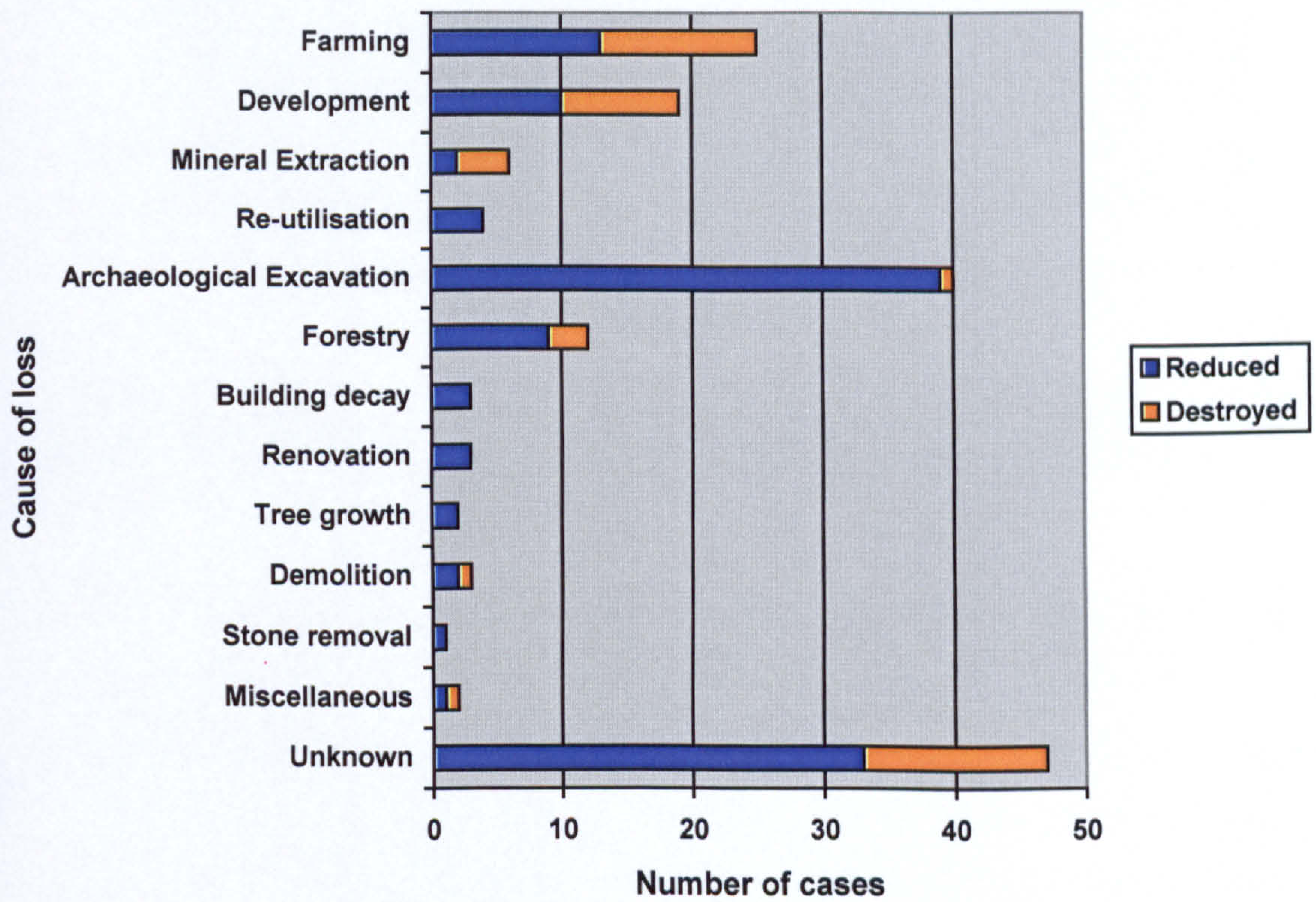

Figure 4.7. Numbers of monument loss cases noted through the desk-based study by cause.

As figure 4.7 shows, the most frequently recorded cause of damage to archaeological monuments since 1850 is archaeological excavation, with 39 cases of reduction and one case of destruction recorded within the sample. The second largest recorded cause is farming, with 12 monuments recorded as destroyed and 13 reduced, while development accounts for a further 19 cases of damage or destruction. Of the 167 damage or destruction cases recorded, 47 are through unknown causes. The dates of recorded damage and destruction are worth examining also, as show in figures 4.8 and 4.9.

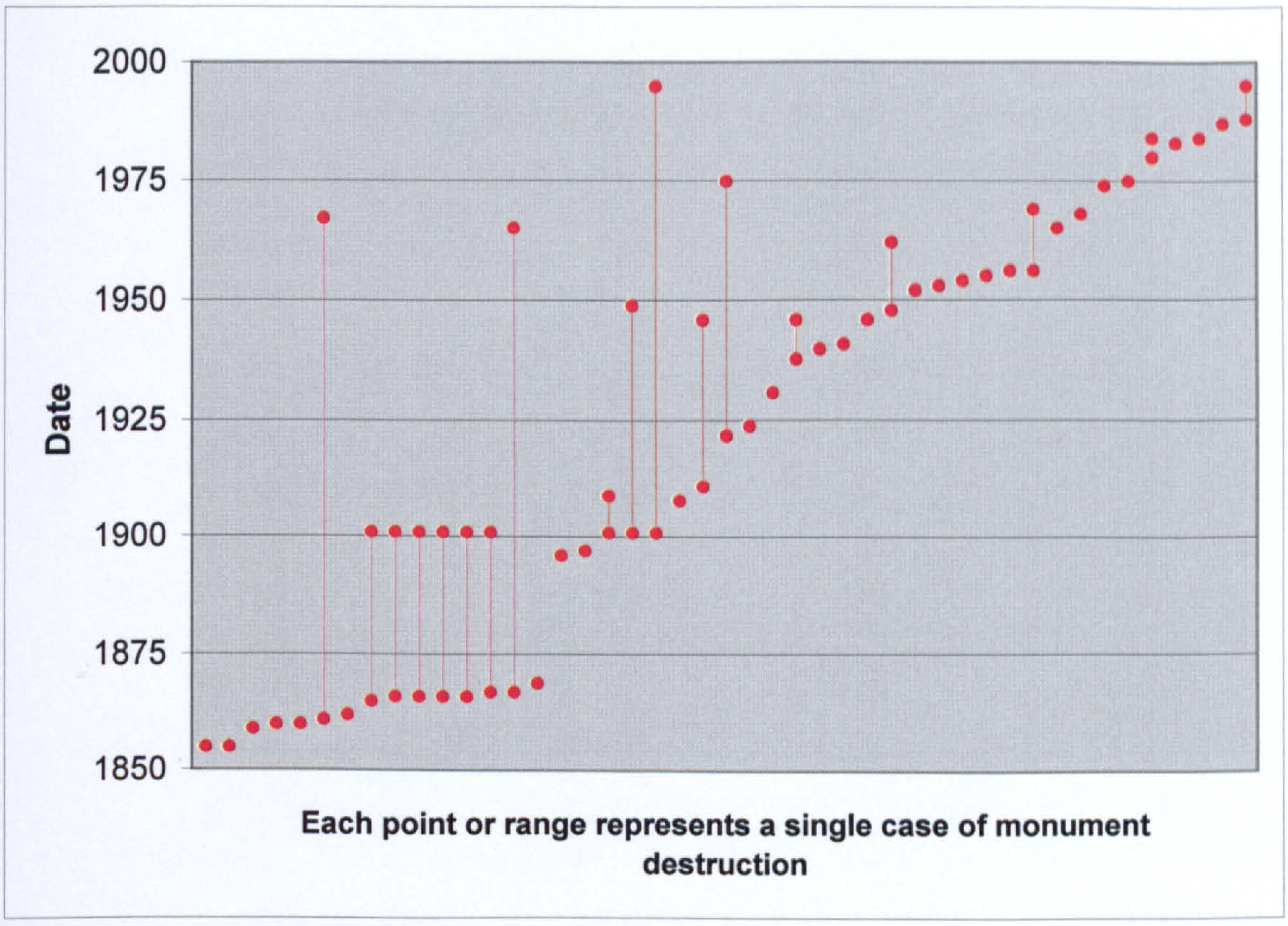

Figure 4.8. Date ranges of all destruction episodes recorded through the desk-based study. Each point or date range represents a case of monument destruction.

As figure 4.8 demonstrates, it has not always been possible to identify the precise date at which destruction has occurred. Wherever possible, precise dates have been identified using aerial photographs and other documentary sources. In some cases, however, photographs and documentary sources have not helped. For example, in figure 4.8, the group of six destruction cases represented by date ranges between 1866-7 and 1901-2 all took place at monuments destroyed at some time between the Ordnance Survey 1st Edition and 2nd Edition mapping. Aerial photographs have not helped identify precise dates or causes of these cases of destruction, and so it has been possible only to identify date ranges within which the monuments are known to have been destroyed. The dates of recorded damage to sample monuments are shown in figure 4.9.

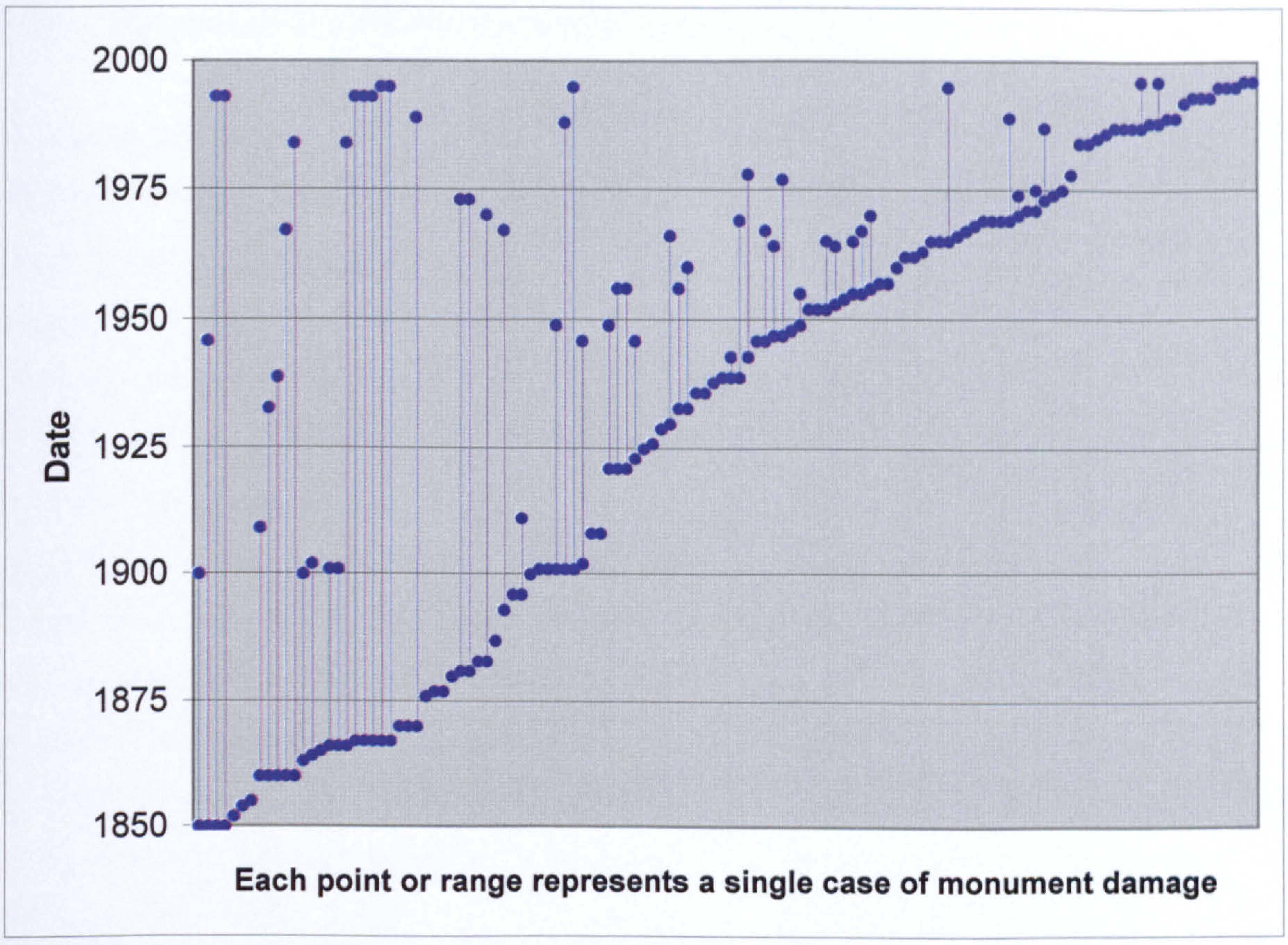

Figure 4.9. Dates of all damage episodes recorded through the desk-based study. Each point or date range represents a case of monument damage.

For many of the monuments damaged or destroyed more recently, it has been possible to identify more precisely the dates of damage or destruction, as figures 4.8 and 4.9 demonstrate. In some cases, the date is recorded precisely in the NMRS, while in others, aerial photographs have enabled the narrowing of date ranges. In addition, there is greater detail of damaging events that have taken place in recent years in the NMRS. Although figures 4.8 and 4.9 suggest an increase in frequency of damage to monuments in the last 50 years, it must be emphasised that the desk-based study records the date when monuments have been first *recorded* as having been reduced or destroyed. In some cases, a significant period of time has elapsed between a dated NMRS description identifying damage to a monument and the dated description preceding it. In such cases (where the time-lag may be as much as 140 years), the actual date of destruction could fall anywhere between the two dated NMRS descriptions in question.

4.5.2 The accuracy assessment and causes of monument loss

As described in section 4.3, the accuracy assessment undertaken in order to calibrate the results of the desk-based study has shown that many cases of damage have occurred which have not been recorded through the desk-based study. This has come about either because damage has occurred since the last dated NMRS description of a monument or because the damage has not been noted in the NMRS. At the 258 monuments examined as part of the accuracy assessment, the desk-based study has identified 90 cases of damage (at 65 monuments), but the accuracy assessment has recorded a further 58 damage cases (at 46 monuments). This suggests that the desk-based study may have identified only about 60% of damage cases since 1850, although it should be remembered that the sample of monuments on which the accuracy assessment is based has not been selected at random, but contains a disproportionately high number of monuments recorded as reduced by the desk-based study. Because of the potential biases in the data used in the accuracy assessment, numbers of damage cases identified through the accuracy assessment have not been used to calibrate the numbers of damage cases identified through the desk-based study. Instead, the accuracy assessment provides an indication of types and scale of damage which may not have been detected through the desk-based study.

Condition Calibration Method	Number of Monuments Checked	Number of new damage episodes identified
Vertical Aerial Photographs	69	11
Oblique Aerial Photographs	70	3
Monument Warden Reports	58	20
Field Survey	61	24
TOTAL	258	58

Table 4.12. Summary of numbers of damage cases identified during the accuracy assessment according to checking method used.

Table 4.12 summarises the numbers of damage cases identified during the accuracy assessment, and illustrates that in keeping with the accuracy assessment undertaken to calibrate monument condition change within the sample, field survey and the examination of Monument Warden reports have proved the most effective methods in identifying damage not recorded through the desk-based study. The totals of damage types identified through the accuracy assessment are summarised in figure 4.10.

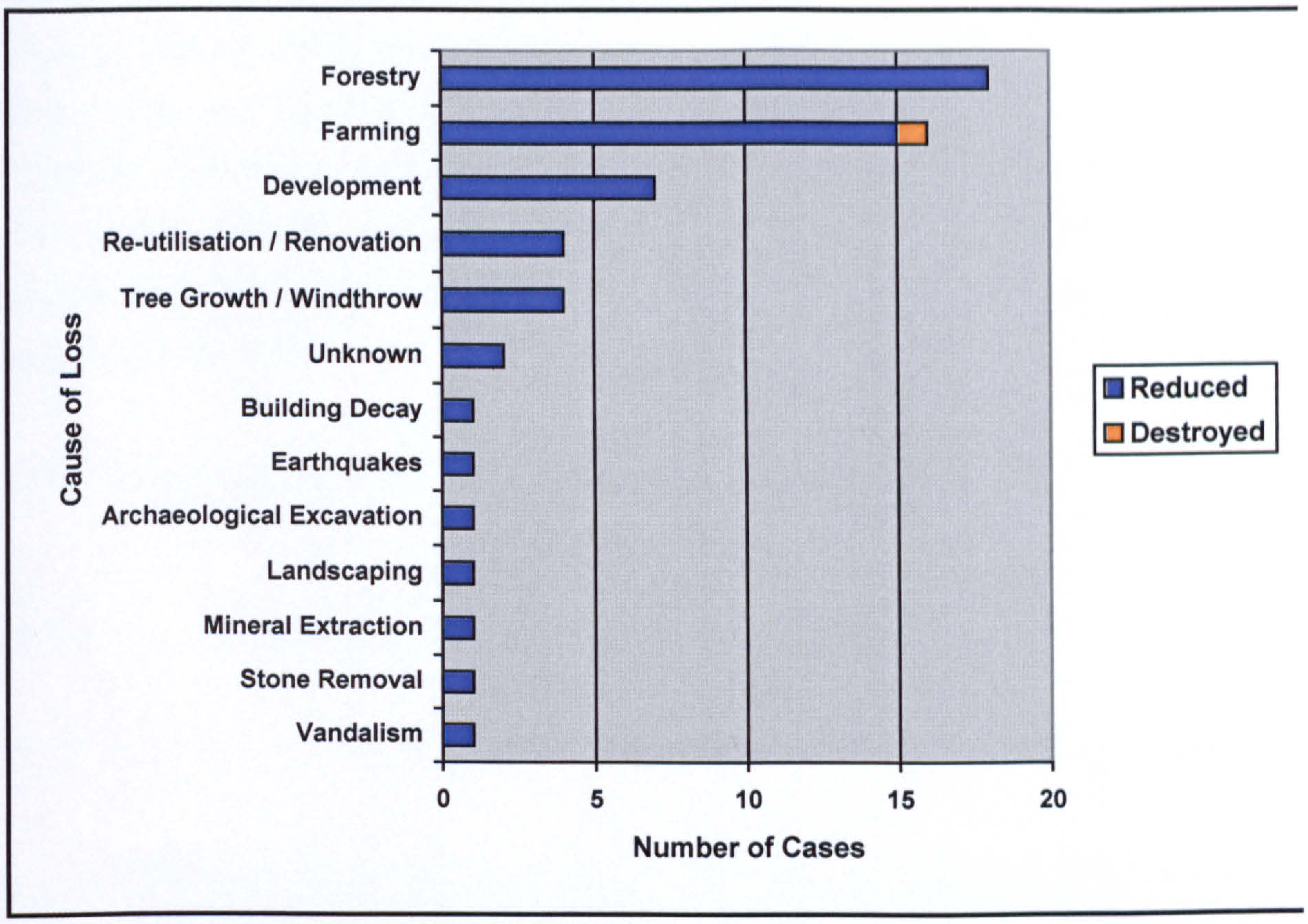

Figure 4.10. Numbers of cases of monument damage and destruction noted through the accuracy assessment.

Although no calibration of the damage case totals recorded through the desk-based study has been attempted, as figure 4.10 demonstrates, the accuracy assessment has identified several damage types not included in the desk-based study because they have not been mentioned in the NMRS. These include earth tremors, poaching by cattle, and windthrow. In addition, 16 cases of farming-related damage and 18 cases of forestry-related damage have been recorded through the accuracy assessment, none of which were recorded through the desk-based study. Nine of the 12 new farming damage cases occurred at monuments where no damage has been recorded through the desk-based study, and 17 of the 18 forestry episodes occurred at monuments where no damage has been recorded through the desk-based study. This indicates that monument loss attributable to farming and forestry operations since 1850 is likely to have been far more significant than suggested by the desk-based study.

The desk-based study has suggested that the most common causes of monument loss recorded in the NMRS are archaeological excavation, farming and forestry, and that a substantial number of damage cases have been due to unknown causes. As well as illustrating shortcomings in the desk-based study as a means of identifying causes of monument damage and loss, the accuracy assessment has emphasised the damaging effects of farming and forestry on monument condition. By examining each of the major damage types identified by the desk-based study and accuracy assessment individually, it has been possible (on occasion) to identify periods within the last 150 years when certain damage types have increased or diminished, enabling a fuller understanding of the processes of change to which the sample monuments have been subjected since 1850.

4.5.3 Specific causes and dates of monument loss identified

4.5.3.1 Recorded damage through unknown causes

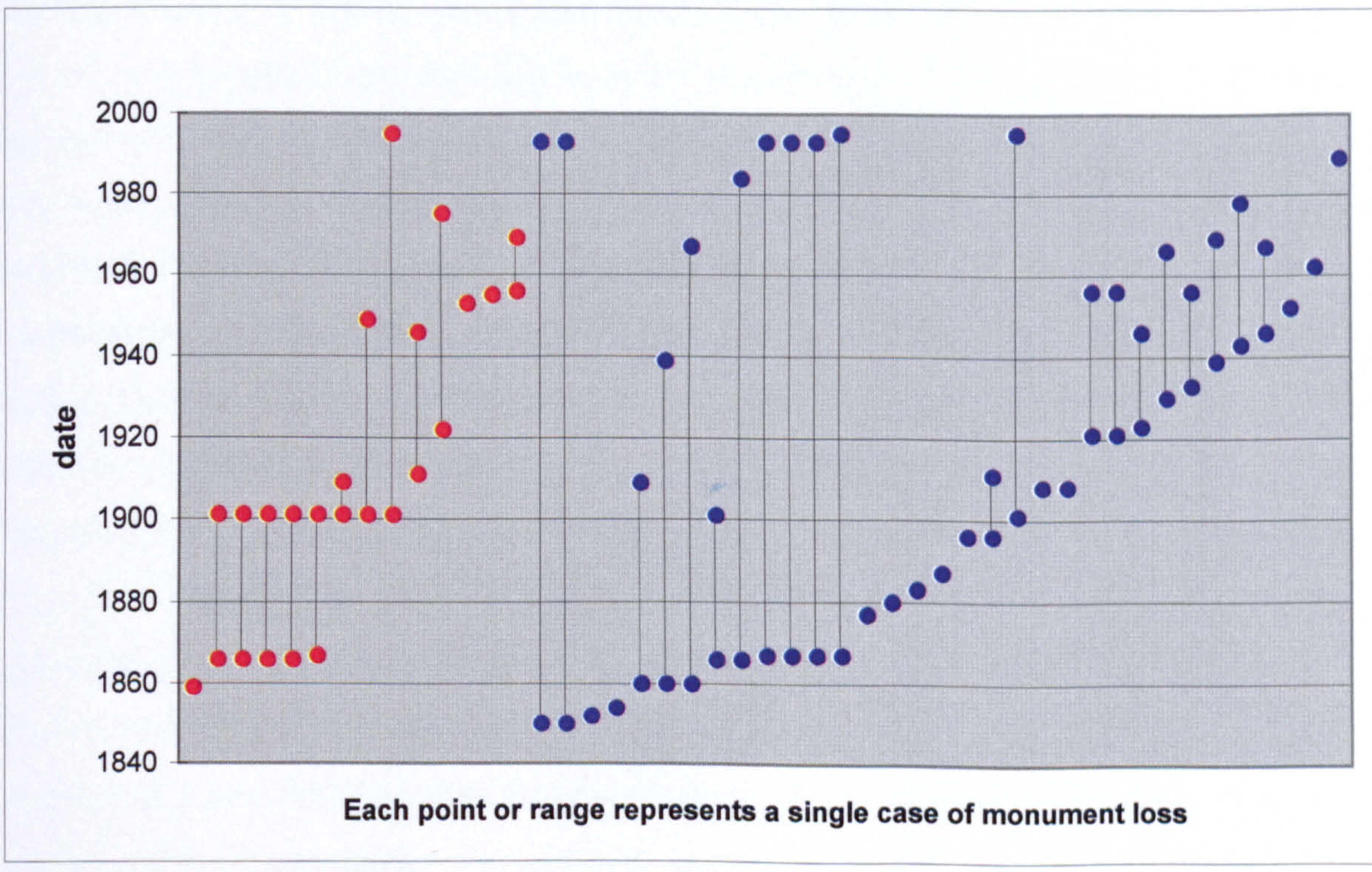

Figure 4.11. Dates of loss recorded through the desk-based study for which cause has not been identified. Red markers denote monument destruction and blue markers denote monument reduction.

As figure 4.11 illustrates, very few of the 47 cases of damage through unknown causes recorded in the desk based study can be ascribed a definite date. For example, the group of destroyed monuments with destruction dates shown as ranges between 1867 and 1901 are all monuments marked on the Ordnance Survey 1st Edition mapping but omitted from the 2nd Edition mapping. While it is recognised that omission from a map does not necessarily demonstrate the destruction, in most of these cases, mapping from the 1920s and 1930s has also been consulted, along with aerial photographs from the 1940s. None of these sources has indicated that any remains have survived to these dates.

Although none of the damage cases indicated in figure 4.11 has been ascribed a precise cause, where possible, a record has been made of the *probable* cause of damage or loss, based on land use, aerial photographs and the NMRS text report. These probable causes fall into three main groups: Farming (14 cases), stone removal (seven cases) and natural building decay (11 cases). The accuracy assessment has identified a further two episodes of damage through unknown causes. Both have been at dovecots recorded as undamaged by the desk-based study, and the damage has been identified using vertical aerial photographs. One case is probably due to natural building decay, while the other is probably due to stone removal.

The significance of the probable farming damage noted here is discussed in section 4.5.3.6, but it is worth considering here the significance of the identified examples of damage probably due to building decay or stone removal. Within the desk-based study, only three cases of building decay and one case of stone removal have been positively identified. A further 20 probable cases have been identified through the accuracy assessment, but it has been virtually impossible to ascribe these cases any precise date. Almost all cases of stone removal recorded have occurred at standing buildings either of medieval or post-medieval date, while damage through building decay has been confined exclusively to such monuments. It is likely that the two damage causes have occurred together frequently, particularly at post-medieval structures, where archaeological significance may not be readily apparent. Furthermore, it could be argued that natural building decay should not be classed as damage, as it merely represents a post-abandonment taphonomic process, and that the rapid deterioration of standing buildings (either through stone removal or through natural deterioration) is of little consequence. To anyone interested in post-medieval or industrial archaeology, however, the loss of such monuments and the rate at which they deteriorate is of importance. With two of the over-arching objectives of this research being to quantify and analyse monument loss since 1850, this quantification is made irrespective of the perceived significance or value of the archaeological remains in question. Consequently, damage through natural building decay is included in analysis throughout this chapter and chapter 5.

4.5.3.2 Damage through archaeological excavation

As figure 4.10 has shown, archaeological excavation is the most frequently recorded cause of monument damage within the desk-based study. Figure 4.12 shows the dates of these recorded excavations, as identified through the desk-based study.

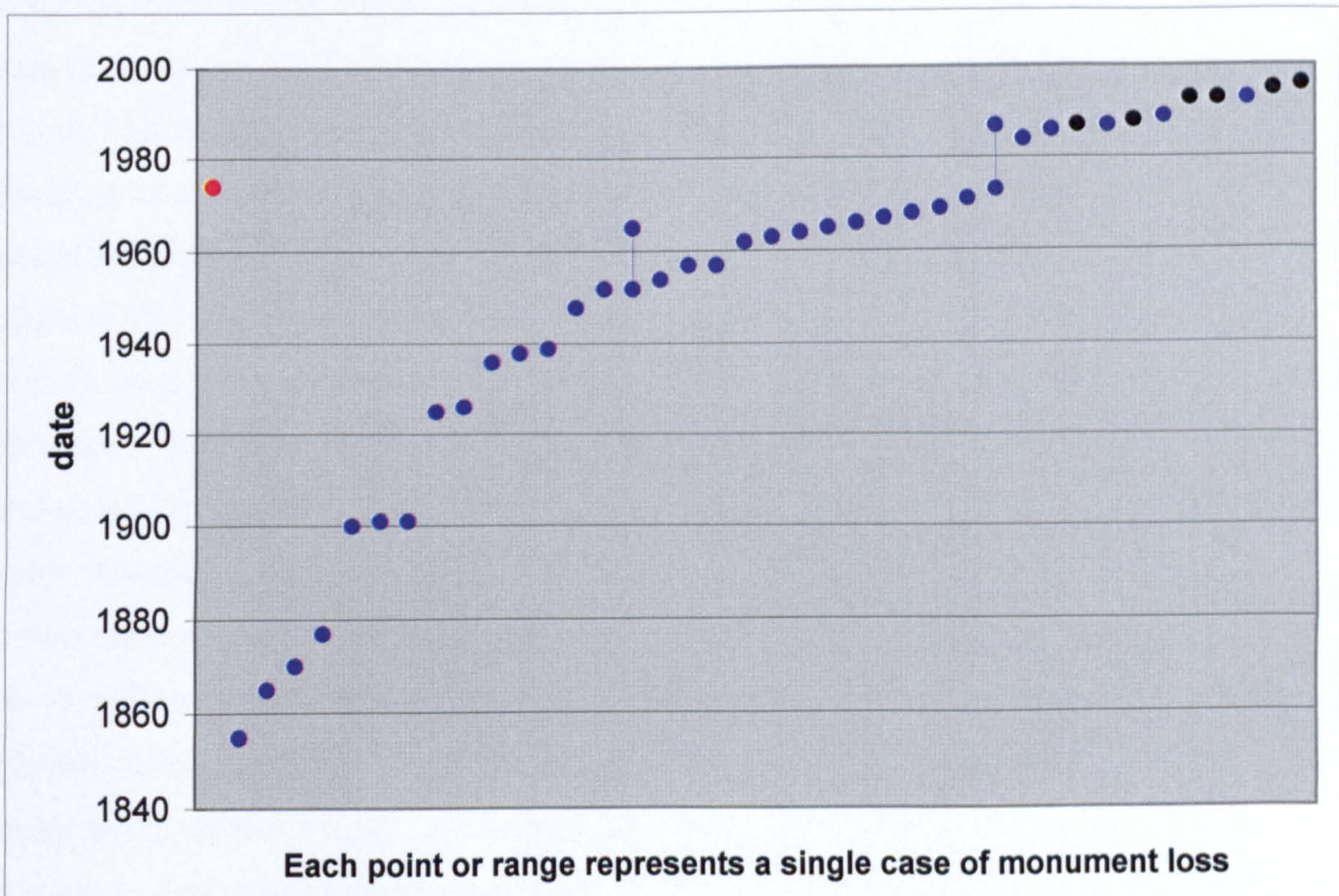

Figure 4.12. Dates of loss recorded through the desk-based study attributable to archaeological excavation. Red markers denote monument destruction and blue markers denote monument reduction. Black markers denote excavation undertaken in advance of development.

Within figure 4.12, the two date ranges represent long-running excavation programmes undertaken at Inchtuthil Roman Fort (NO 13 NW 5, 1952-1965) and Strageath Roman Fort (NN 81 NE 2, 1973-1987). Black points among the most recent excavation dates shown in figure 4.12 represent excavations and evaluations undertaken in advance of development (four cases), agricultural operations (one case) and building consolidation works (one case). The one case of a monument fully destroyed by archaeological excavation is that of a short cist exposed by ploughing in 1974 at Easter Essendy, Perth and Kinross (NO 14 SE 23). Figure 4.12 shows that the NMRS records increasing numbers of archaeological excavations within the sample over the last 50 years or so, and demonstrates the increasing role that developer-funded archaeology has played within the last 20 years. During the accuracy assessment, one further case of damage caused by excavation has been identified, and again, this excavation has been in advance of development.

In assessing the significance of damage caused to archaeological monuments through excavation, it could be argued that as with the natural deterioration of standing buildings, archaeological excavation does not constitute damage. The rationale behind this argument is that if archaeological excavation is carried out properly, archaeological data is recorded fully, and so even when physical remains are removed by excavation, the archaeological data they contain is retained in written records. While this might be possible of modern professional excavation (and even the most competent excavator would struggle to prove that it is), half of the archaeological excavations represented in figure 4.12 took place before 1960, when excavation techniques and, to a lesser extent, lax attitudes towards publication ensured that large amounts of archaeological data have been lost. Preservation of archaeological remains *in situ* is one of the underpinning philosophies of modern archaeological resource management, but in order to expand archaeological understanding through excavation, there is an inevitable trade-off in terms of monument preservation. In order to justify the preservation of archaeological remains (at the expense of development in particular), the nature and significance of the archaeological remains in question must be understood. While modern excavation is, therefore, a necessary component of archaeological resource management, it remains detrimental to the physical archaeological record, and consequently, is treated here as a process of damage.

4.5.3.3 Damage through development

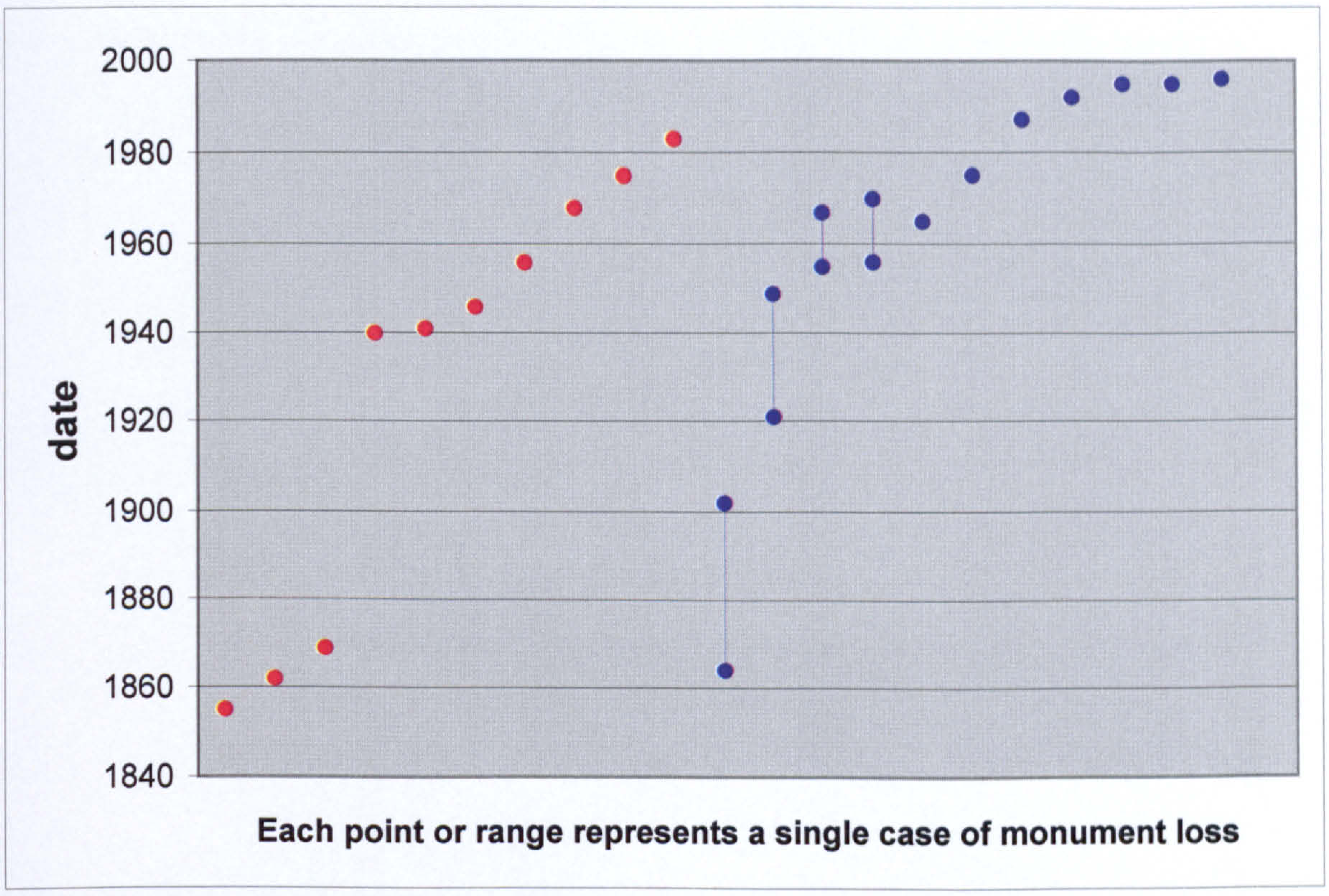

Figure 4.13. Dates of loss recorded through the desk-based study attributable to development. Red markers denote monument destruction and blue markers denote monument reduction.

The damage category of development includes housing/urban development, road building (and associated drainage operations), pipeline construction, flooding for reservoir formation and WW2 development. Although figure 4.13 suggests a marked increase in monument loss since 1940, it is likely that this is indicative of an increase in the recording of monuments damaged or destroyed by development over the last six decades. Of the 21 damage or destruction cases illustrated in figure 4.13, the NMRS includes a note of associated excavations for only four, all within the last ten years. The accuracy assessment has recorded a further seven damage cases occurring due to development. Of these, five have been identified through the use of vertical and oblique aerial photographs, and two have been recorded using Monument Warden condition reports.

In theory, all modern development includes archaeological input to ensure that archaeological remains are wherever possible preserved in situ, but where this is not possible, recorded through excavation before destruction. Studies in both England

(Darvill and Russell 2002) and Scotland (O Sullivan 2001) have highlighted the increasing level of developer-funded archaeological excavation during the 1990s. Similarly, examination of The Council for Scottish Archaeology Journal *Discovery and Excavation in Scotland New Series, Volume 3*, (CSA 2002) shows that 39 of 57 excavations, evaluations and watching briefs in Perth and Kinross, Fife and Angus in 2002 included in the volume were developer-funded. Nine were funded by Historic Scotland or the relevant Local Authority. By contrast, only three of the excavations noted were exclusively for research purposes and funded by universities or research boards. Not only does this illustrate the current dominance of developer-funded excavation in archaeology, but emphasises the threat that development poses to the archaeological resource.

4.5.3.4 Damage through mineral extraction

Although mineral extraction could be included in the damage type category of development, it has been treated separately for the purposes of analysis, as small-scale mineral extraction in agricultural land (which even today is not regulated by the planning system) is included in this category. By analysing cases of damage caused by mineral extraction separately from other development related damage, it was hoped that episodes of damage attributable to mineral extraction could be identified. This has not proved possible, however.

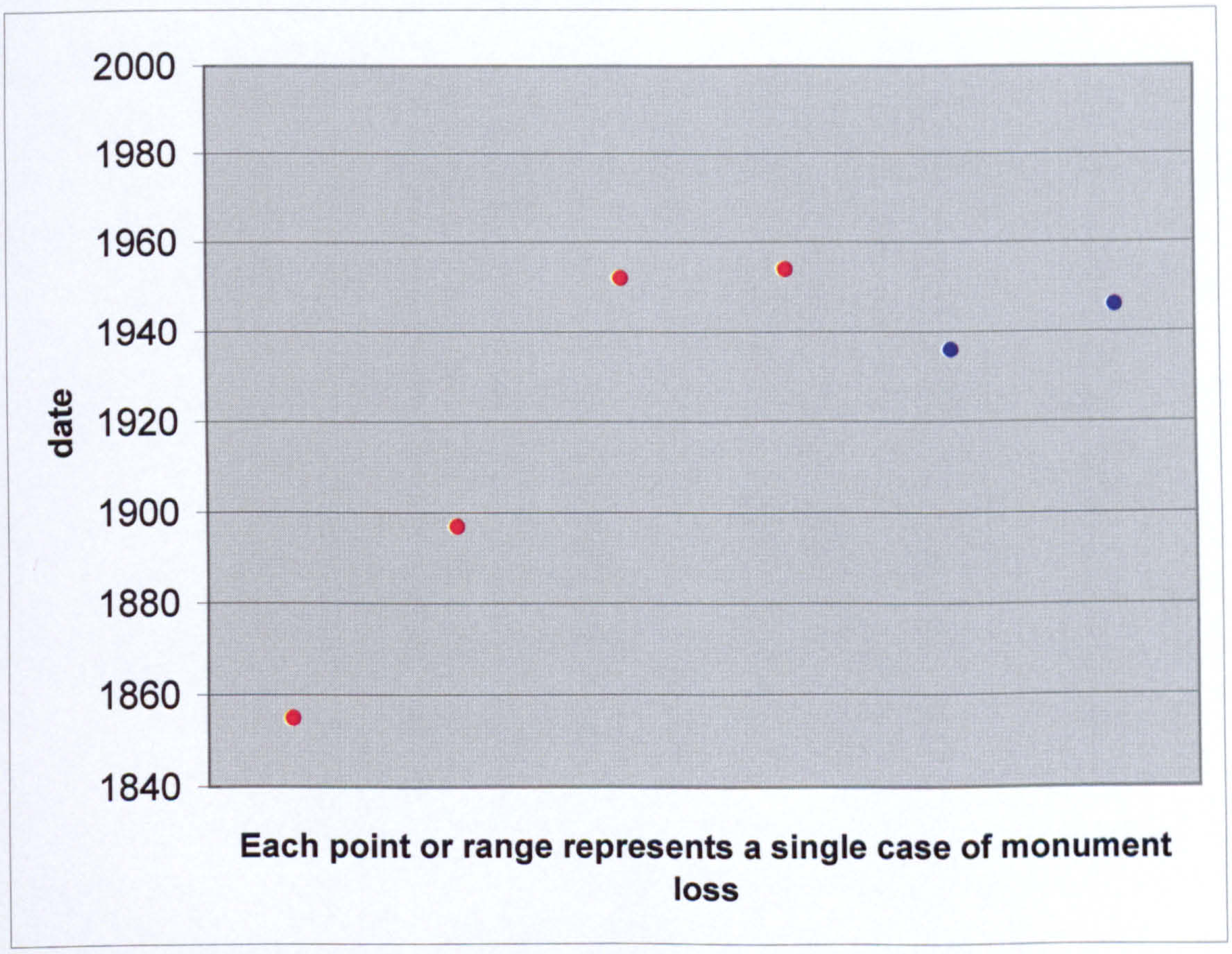

Figure 4.14. Dates of loss recorded through the desk-based study attributable to mineral extraction. Red markers denote monument destruction and blue markers denote monument reduction.

As figure 4.14 shows, the NMRS makes no record of any monuments having been damaged or destroyed through mineral extraction since the late 1950s. In each recorded case shown in figure 4.14, the monument destroyed has been cist or cremation cemetery, which has been noted only during its destruction. Of the six cases shown in figure 4.14, four have occurred through large-scale extraction, with two occurring through small-scale extraction carried out by individual farmers. The accuracy assessment has identified one further case of damage through mineral extraction. This occurred through small-scale extraction some time between 1946 and 1960, though in the vertical aerial photographs from which the damage has been identified, it is not clear what type of individual or organisation carried out the extraction.

Although figure 4.10 suggests that mineral extraction has played only a small role in monument loss since 1850, it is likely that monument destruction through mineral extraction has been greater than the desk-based study and accuracy assessment indicate. Buried monuments such as cists remain particularly vulnerable to the mechanisms of mineral extraction, and it is likely that many such monuments have been destroyed without record within the study area, simply because they have not been identified. Without evidence, however, this loss is impossible to quantify. It is possible to conclude only that the desk-based study and accuracy assessment have not proved successful means by which to identify damage to monuments caused by mineral extraction.

4.5.3.5 Damage through forestry operations

Through both the desk-based study and accuracy assessment, forestry has been identified as a significant cause of monument loss within the study area, particularly in highland Perthshire. Figure 4.15 illustrates the dates of damage and destruction attributable to forestry operations identified through the desk-based study, and shows that the majority of this loss has occurred since 1960. All but one of the 12 cases of monument loss shown in figure 4.15 have been through ploughing and tree planting, while the final case of damage has been caused by tree removal between 1902 and 1946.

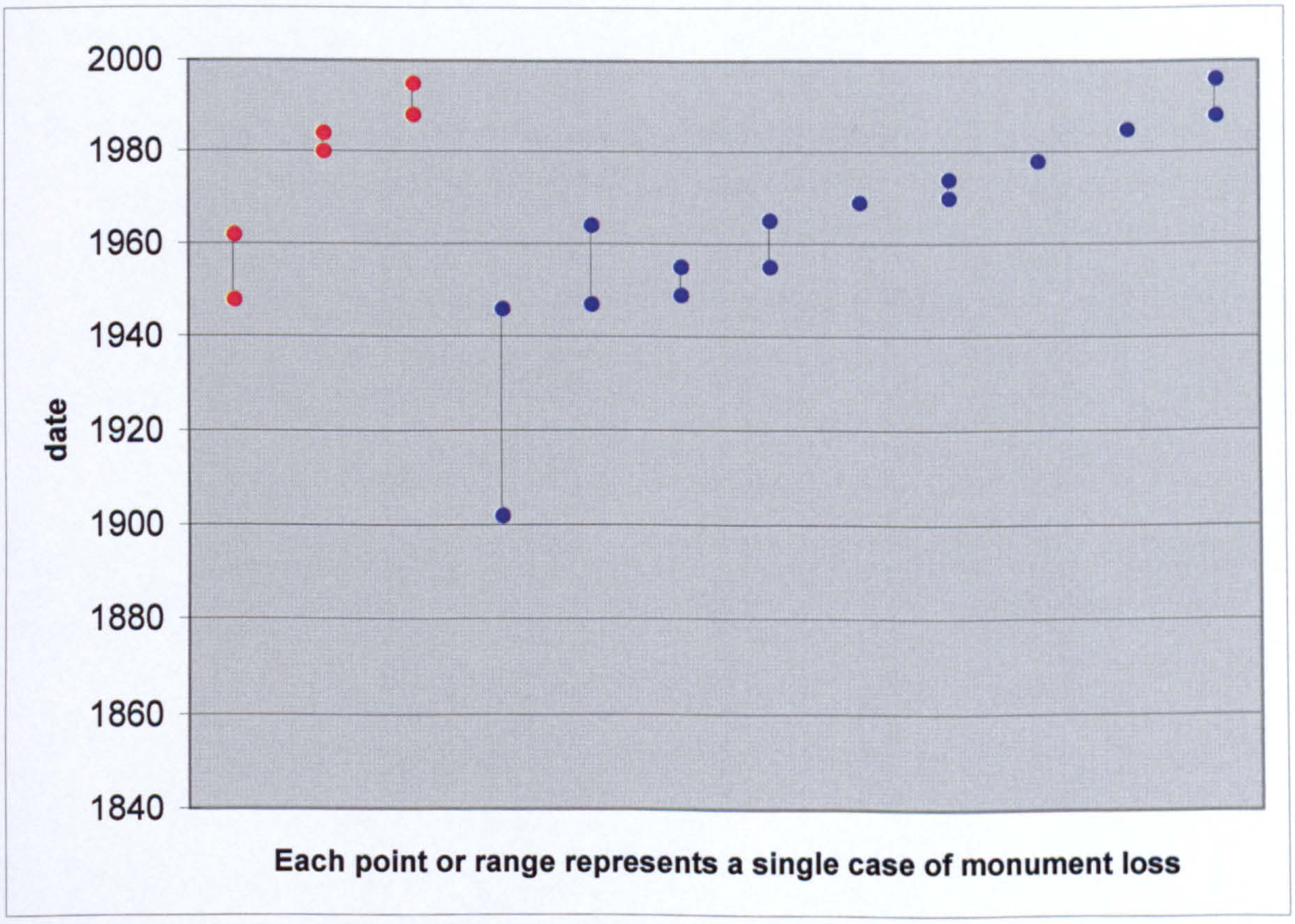

Figure 4.15. Dates of loss recorded through the desk-based study attributable to forestry. Red markers denote monument destruction and blue markers denote monument reduction.

The accuracy assessment has identified a further 18 cases of damage due to forestry operations. Nine of these cases have occurred through tree planting, five through forestry ploughing across archaeological remains (though the remains may not necessarily have been planted), and two through vehicle damage and the creation of access tracks associated with forestry. The two remaining cases of damage identified through the accuracy assessment are one case where windthrow has lifted a number of root-plates, causing disfigurement to the rig and furrow below, and one case where drainage ditches have been cut through a monument.

The dates of the forestry damage cases recorded through the accuracy assessment are shown in figure 4.16, and in keeping with the damage cases identified through the desk-based study, all have occurred since the Second World War.

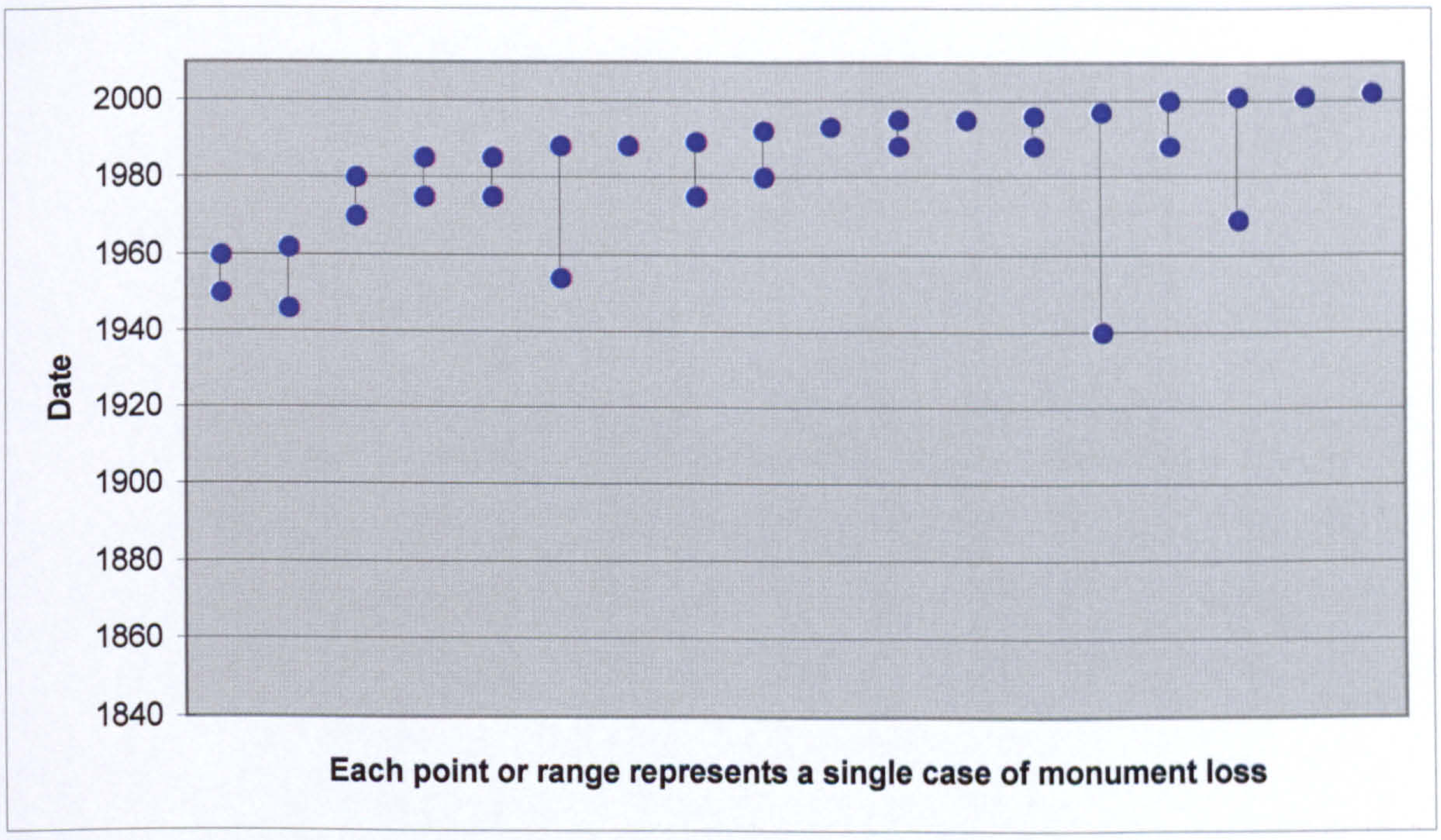

Figure 4.16. Dates of loss recorded through the accuracy assessment attributable to forestry. Red markers denote monument destruction and blue markers denote monument reduction.

Of the 18 cases of forestry related damage identified through the accuracy assessment, only one has taken place at a monument previously identified as damaged through the desk-based study. This suggests that forestry has posed a greater threat to archaeological remains within the study area since the 1940s than the desk-based study alone has suggested. The accuracy assessment has also highlighted the extent of the range of forestry-related activities with negative implications for archaeological remains, including vehicle damage and drainage works. It is worth noting that natural conifer regeneration was recorded at three of the five monuments located in forestry clearings surveyed as part of the accuracy assessment. This has not been included in figure 4.16, however, as monument condition change attributable to this regeneration could not be confirmed.

4.5.3.6 Damage through farming-related activities

As described in chapter 1, farming operations remain a significant threat to archaeological remains. Within the study area, about 80% of land is agricultural (about 50% arable or improved, and about 30% non-intensive land uses such as rough grazing and heather moor), and about 75% of the sample monuments are located in agricultural land (50% in arable or improved land, and about 25% in non-intensive land uses).

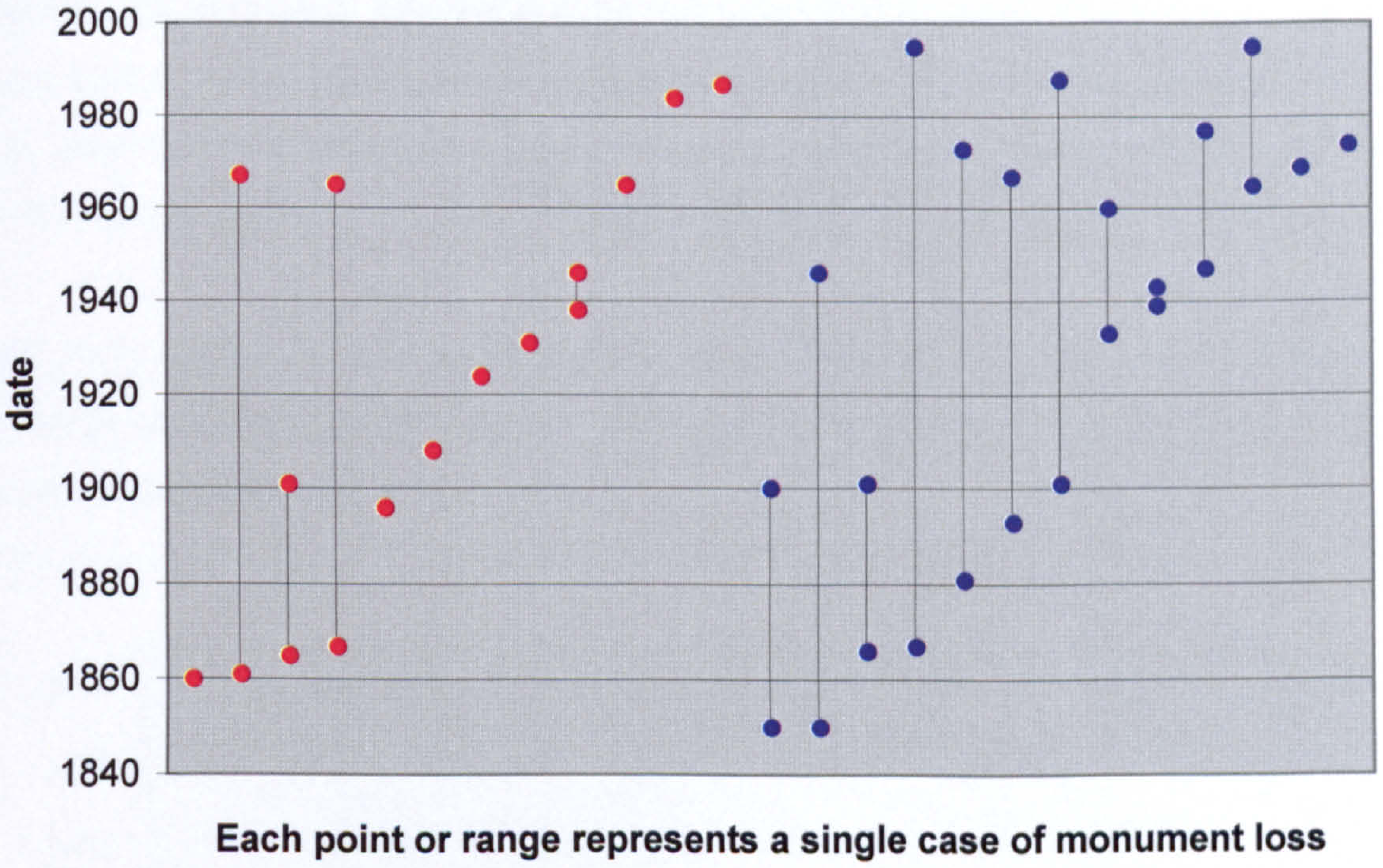

Figure 4.17. Dates of loss recorded through the desk-based study attributable to farming-related activities. Red markers denote monument destruction and blue markers denote monument reduction.

The types of farming-related damage shown in figure 4.17 include ploughing (19 cases), field clearance stone dumping (one case) and removal of monuments to increase the size of a cropping area (four cases). The final case is that of a water meadow drained and converted to pasture between 1866 and 1901 (NN 91 NW 104). Of the 19 episodes of plough damage recorded, ten are cases where ploughing has dislodged buried features such as cists, five are cases where gradual encroachment has taken place, reducing the overall dimensions of the surviving archaeological features. Four are cases where continued ploughing has had the effect of reducing the height and profile of earthworks.

Fourteen cases of monument loss identified through the desk-based study for which no precise cause can be ascertained are likely to have been caused by farming operations. Of these fourteen cases, nine (all occurring before 1960) have seen the destruction of monuments, three where cists have been destroyed in arable land, five where post-medieval buildings (including a dovecot) have been removed from arable land, and one case where a standing stone has been removed from arable land. Of the five cases of monument reduction identified, two have been cases where an earthwork profile has been reduced in arable land, probably through ploughing. The remaining three cases of reduction have seen a souterrain disturbed in arable land, a standing stone toppled in arable land, and human remains from a medieval burial ground discovered in arable land. While it is acknowledged that some of these cases may have been caused by other factors (such as gravel quarrying, for example), given the land uses in which the monuments have been located, agricultural damage is seen as the most likely explanation.

The accuracy assessment has identified a further 15 cases of monument reduction and one case of monument destruction due to farming operations. The date ranges of these cases are shown in figure 4.18.

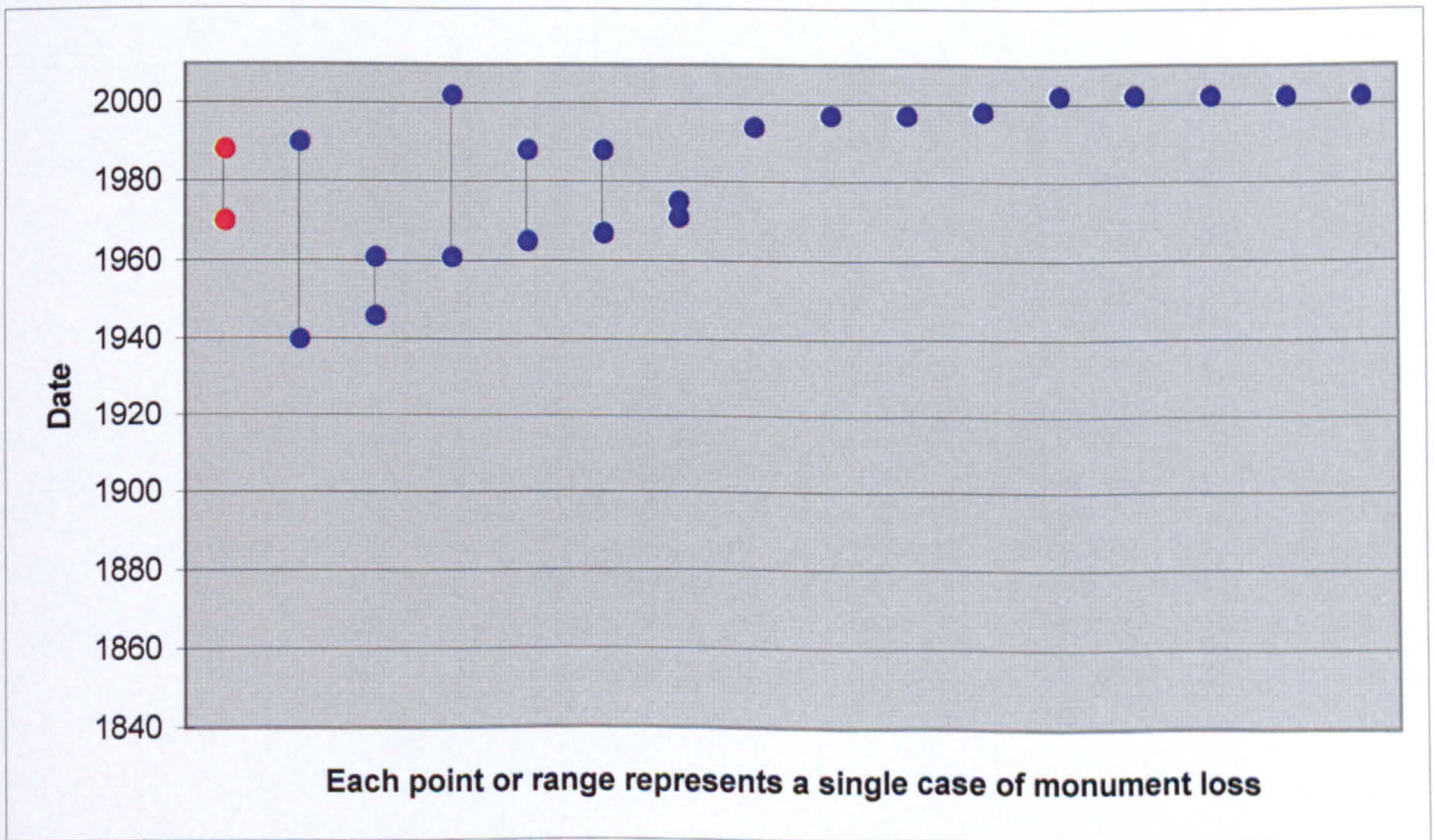

Figure 4.18. Dates of loss recorded through the accuracy assessment attributable to farming. Red markers denote monument destruction and blue markers denote monument reduction.

Of the 16 cases shown in figure 4.18, only five have been identified at monuments recorded as damaged by the desk-based study. Unlike the farming-related damage recorded through the desk-based study, which is dominated by disturbances to buried features, the accuracy assessment has identified significant damage to extant monuments. The 16 cases identified include four examples of plough encroachment on earthworks (in one case, turning upstanding remains into cropmarks is a very short space of time), and one case where a dovecot has been removed completely, probably to increase the area of land available for cultivation. More unexpectedly, three cases of damage caused by ground poaching by livestock have been identified, along with five cases of damage caused by farm vehicles. Although the latter eight cases of damage are markedly different in nature from the types of agricultural damage noted through the desk-based study, their significance should not be underestimated. At one of the monuments surveyed as part of the accuracy assessment, a group of seven predominantly turf-walled structures had been reduced by cattle poaching and vehicle damage to such an extent that two structures could not be located, while a further three had been partially destroyed. In such cases, once stock have been removed from the area of the monument and the vegetation reinstated, there is little chance of determining the cause of damage to the monument. Because the visible manifestations of livestock damage are often temporary in nature, livestock damage cannot always be identified, and consequently, it is likely to be under-represented in the results of both the desk-based study and accuracy assessment.

4.5.3.7 Miscellaneous causes of monument loss

A number of damage cases have been identified through the desk-based study and accuracy assessment which do not fall readily into any of the categories already outlined. These fall into two groups, namely those of anthropogenic origin and those of natural origin. The majority of the anthropogenic damage types (the dates of which are shown in figure 4.19) are usually associated with standing buildings, although one of the four cases of re-utilisation identified has involved the creation of a shelter within a prehistoric burial cairn, probably in the 1960s.

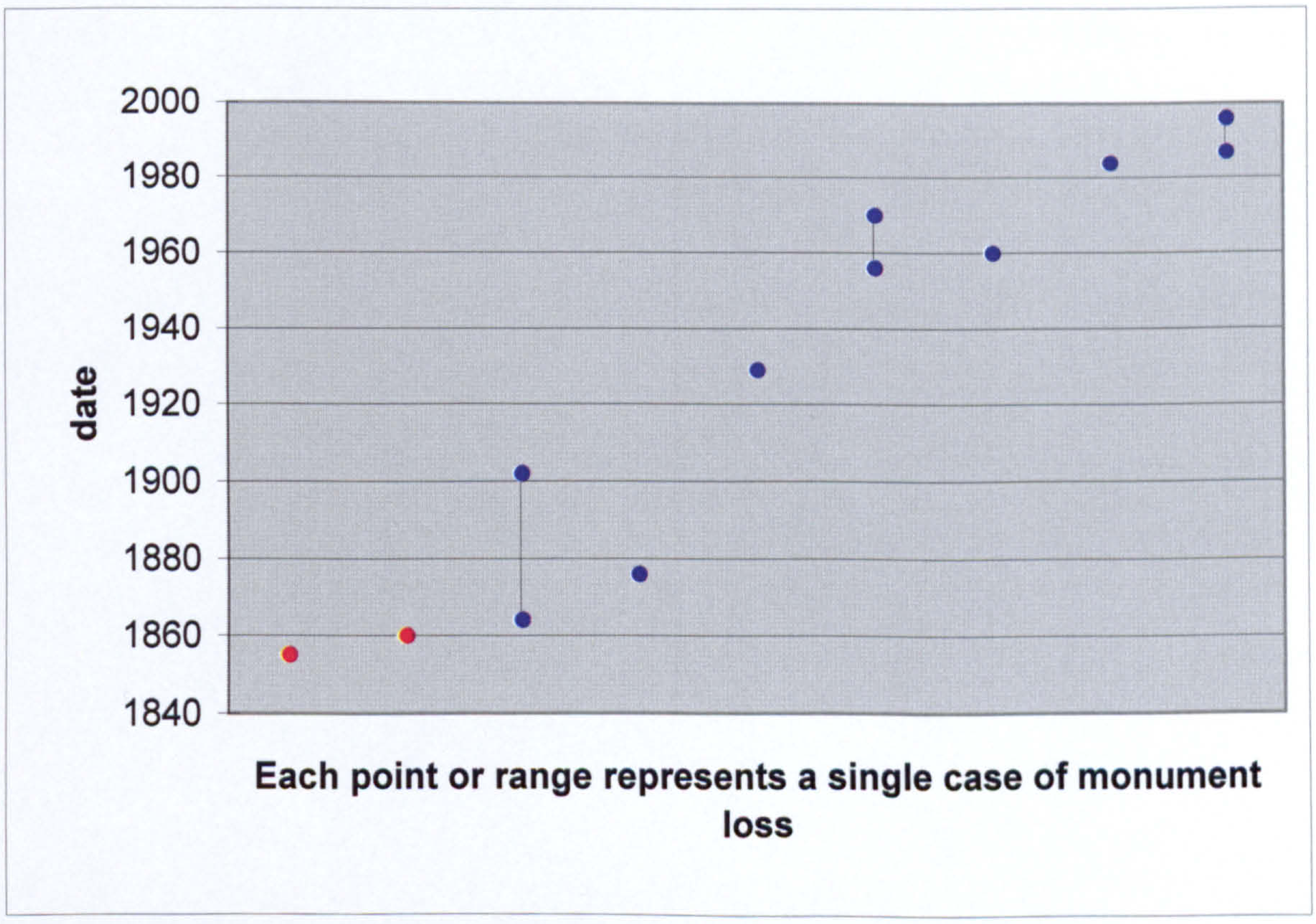

Figure 4.19. Dates of loss recorded through the desk-based study attributable to miscellaneous anthropogenic causes. Red markers denote monument destruction and blue markers denote monument reduction.

This case aside, all damage noted through the desk-based study attributable to re-utilisation has occurred before 1940. By contrast, two of the three damage cases through renovation have occurred since 1984. The demolition of three standing buildings is represented also in figure 4.19. Two of these demolition cases took place in the late 19th century, with the third occurring in the 1960s. The accuracy assessment has identified a further three cases of renovation and a single further case of re-utilisation, all of which have occurred since 1989.

While it is acknowledged that renovation and building re-utilisation may aid long-term preservation of a monument, there is an inevitable loss of archaeological material during such operations. Non-intervention at standing buildings will lead to their eventual collapse, and so it could be argued that by recording both natural building decay and building renovation and re-utilisation, the results of the desk-based study and accuracy assessment are self-contradictory. Either way, both processes lead to a change in the condition of a monument and the loss of archaeological information, and so both are included in analysis as agents of monument loss. In addition to damage to standing buildings caused by renovation and building decay, two cases of monument reduction through vandalism have been recorded, one though the desk-based study and one through the accuracy assessment. The final anthropogenic cause of monument damage noted through the desk-based study is landscaping. This has accounted for one case of destruction.

The natural damage type noted through the desk-based study is reduction through natural tree growth (distinct from forestry), two cases of which have been identified. Given that some 5% of the 779 monuments included in the desk-based study are situated in semi-natural woodland, it is inevitable that more cases of tree-induced damage to monuments will have occurred than the desk-based study has identified. From the NMRS records consulted, however, positive identification of this damage has been possible only twice. The accuracy assessment has identified a single case of monument damage caused by tree growth, but has also identified three cases where monuments have been damaged as a result of windthrow, either because root plates have been wrenched from the ground, or because the falling trees have damaged standing structures. The final case of naturally induced damage recorded through the accuracy assessment is that of a medieval tower-house damaged by an earth tremor in 1981.

All of the natural damage causes described are, with the exception of the earth tremor, preventable through the careful management of woodland. The management of mature woodland is expensive and frequently impractical, however, and so damage caused by tree growth and windthrow is perhaps inevitable. Although tree growth on archaeological monuments is widely regarded as damaging due to the disturbance caused by tree roots, Crow (2001) has pointed out that the precise impacts of trees on archaeological deposits remain poorly understood. Different tree species show a wide diversity of rooting systems, and so it is reasonable to suggest that some species are likely to cause greater damage to archaeological deposits than others. Meanwhile, Fojut (2002) has discussed the possibility that the management of archaeological monuments within existing woodland may be preferable to the removal of trees and the complications caused by regeneration following the removal of vegetation. Furthermore, the results of the monuments census presented in chapter 3 show incidence of recorded monuments in semi-natural woodland within the study area is high, suggesting that despite the potential for root incursion and the risk to archaeological deposits from windthrow, mature semi-natural woodland over large areas constitutes, at least in relative terms, a stable and benign land cover type.

It is worth noting that many other natural damage types (such as bracken growth and burrowing animals) have been noted during field survey and examination of Monument Warden reports, but have not been included in this chapter. They have been omitted from analysis for two reasons. Firstly, it has not always been possible to demonstrate that these damage types have caused a change in monument condition since 1850. Secondly, these damage types are largely ongoing processes, rather than events, and are commonly regarded as ongoing management issues. While their significance should not be underestimated, their inclusion in the accuracy assessment would have led to virtually all monuments examined being recorded as reduced (even where monument reduction was impossible to demonstrate), therefore affecting the calibration of the desk-based study monument condition change statistics.

4.6 Monument loss and its causes: summary and conclusions

The two research objectives examined in this chapter are:

1. The quantification and analysis of monument loss within the study area since 1850.
2. The identification and evaluation of the processes responsible for this loss.

In addition, this chapter has sought to identify any episodes of monument loss which might have occurred and to identify the reasons for these episodes. The results of the desk-based study and accuracy assessment are summarised here.

As this chapter has shown, there has been significant loss of monuments within the study area since 1850. Among monuments extant in 1850, calibrated results suggest that at least 39% have been reduced in extent, with at least 5% destroyed. Among cropmark monuments, visible damage has been considerably less. According to the calibrated results of the desk-based study, at least 5% have been reduced in extent since 1850, although only about 1% have been destroyed. As noted earlier in the chapter, however, this is certain to be a significant under-representation of actual loss rates at cropmark monuments within the study area. Finally, among non-cropmark buried features, loss has been high, with about 75% destroyed and about 18% reduced. This high level of loss is attributable to the mechanisms of discovery of such monuments, as few are recorded unless disturbed, and in contrast to the results suggested for cropmark monuments, there is no doubt that these figures are an over-representation of actual rates of loss at non-cropmark buried monuments. The results presented above illustrate that although a desk-based approach to identifying monument loss can be used with some success, this success is heavily dependant on the amount of information available on current and past monument condition. The desk-based study has proved a productive method by which to assess loss among extant monuments, but the results produced for cropmark and non-cropmark buried features cannot be treated as representative of actual patterns of monument loss.

The desk-based study has identified archaeological excavation, farming and development as the three largest known causes of monument loss since 1850, though due to the lack of information in some NMRS records, a substantial quantity of damage has occurred for which a cause cannot be ascertained. Forestry operations and mineral extraction have been identified as the fourth and fifth largest causes of monument loss, *while damage types particular to standing structures, such as renovation, re-utilisation and demolition have also been recorded. Damage attributable to natural causes such as tree growth and natural collapse account for a very small proportion of the damage recorded, underlining the fact that most damage to archaeological monuments can be* attributed to human activity. The accuracy assessment has emphasised the negative impacts of farming, forestry and development on the archaeological resource, and has also identified damage types not noted through the desk-based study, including stock erosion, vehicle damage and earth tremors.

While the results of the desk-based study suggest that monument loss has been accelerating over the last five decades, it is important to recognise that the recording of archaeological monuments has improved in this period. On the basis of dated descriptions in the NMRS, it is easier to identify damage from detailed recent reports than from the less detailed reports of a hundred years ago. It should be acknowledged also that it has not been possible to ascribe a firm date to many of the cases of damage or destruction noted through the desk-based study. In addition, many of the cases of loss have only come to light in the last 20 years, through RCAHMS field survey programmes and more recently, the First Edition Survey Project. These caveats aside, it is unquestionable that the forestry-related damage recorded has occurred almost entirely within the last four decades, and although this loss appears to have been concentrated in the 1960s and 70s when large-scale ploughing and planting was taking place with little or no archaeological input. Even where ploughing and planting occurred 30 or 40 years ago, the potential for ongoing damage to archaeological features remains high, with drainage operations and vehicle damage noted through the accuracy assessment within the last five years. The desk-based study has also shown that nearly all recorded development-related monument loss has occurred since 1940, although this is probably attributable at least in part to the improved recording of archaeology prior to development within the last 30 years.

While this chapter has addressed two of the over-arching research objectives with some success, the quantification and analysis of monument loss and identification of the processes responsible has been undertaken with little reference to the physical landscape within which the monuments are set. The specific research objectives set out in chapter 2 include the identification of the impacts of environmental factors such as land use and elevation on monuments within the study area. This chapter has provided general statistics on monument loss within the entire sample of 779 monuments, and in chapter 5, this monument loss is set within its environmental context.

Chapter 5

5 Monument condition change in its environmental context

In chapter 4, monument loss within the study area and its causes have been examined. Calibrated results of the desk-based study have shown that among sample monuments extant in 1850, at least 39% have been reduced in extent, with at least 5% destroyed. However, the desk-based study has proved less effective in identifying the loss of cropmark monuments. Calibrated results, which are likely to under-estimate loss to cropmark monuments, suggest that at least 5% have been reduced in extent since 1850, although only about 1% have been destroyed. Conversely, among non-cropmark buried features, recorded loss has been high, with about 75% destroyed and about 18% reduced. As noted in chapter 4, this high level of identified loss is attributable to the mechanisms of discovery of such monuments. As chapter 3 has shown, in examining monument distribution patterns, it is important to be aware of the impacts that environmental variables and data biases will have on perceived distributions. Similarly, in quantifying monument loss, the same variables and potential biases must be addressed. In this chapter, the same overarching research objectives are addressed as in chapter 4. These objectives are:

1. The quantification and analysis of monument condition change in eastern central Scotland since 1850.

2. The identification and evaluation of the processes responsible for observed changes in monument condition.

In this chapter, however, the specific research objectives identified in chapter 2 relating to environmental variables are addressed, in order to enable greater understanding of the factors and processes that have affected sample monuments over the past 150 years. This chapter seeks to address the following research questions:

1. Based on the data sources available, is it possible to identify differences in the survival of monuments according to the Local Authority area in which they are situated?

2. What have the impacts of land use and land use change been on the monuments within the study area since 1850?

3. How does monument condition change since 1850 relate to Land Capability for Agriculture classification?

4. How does monuments condition change since 1850 relate to the altitude at which monuments are situated?

5. Is it possible to identify variations in long-term survival of monuments due to the materials from which they are constructed?

6. How does monument condition change since 1850 relate to the period of construction of sample monuments?

7. Is there a noticeable difference in current condition patterns of scheduled and unscheduled monuments? If so, to what extent are these differences attributable to scheduling?

Initially, all quantification of monument loss presented here is based upon monument condition histories produced through the desk-based study, each based on NMRS records for each of the sample monuments. These results are examined in relation to the environmental variables identified above, and as with chapter 4, they have been calibrated using the results of the accuracy assessment. The causes of monument loss identified through the desk-based study and accuracy assessment are examined also.

It should be noted that as with chapter 4, the term 'monument loss' is used here to signify both monument damage and monument destruction. Where distinction between the two is required, specific reference is made. It should be noted also that calibration in this chapter is based upon the desk-based study results produced for all 779 sample monuments, irrespective of the number of dated records for each monument in the NMRS. Calibration is based upon accuracy assessment results produced using all methods of verifying monument condition. As shown in chapter 4, field survey and the consultation of Historic Scotland Monument Warden reports have provided greater accuracy in the identification of previously unrecorded damage than the use of aerial photographs. Due to the small numbers of monuments within certain condition or environmental variable categories (only 16 of the monuments examined during the accuracy assessment are situated in LCA Class 6 land, for example), however, it has been necessary to use all 258 of the monuments used in the accuracy assessment to calibrate the results of the desk-based study. Consequently, the calibrated results used in this chapter are not fully representative of actual damage rates, and in most cases, actual loss rates are likely to be higher. The few exceptions to this rule have arisen where calibration has been based upon a very small number of monuments examined through the accuracy assessment. In such cases, there is potential for biases in the calibrated results produced, given the small numbers of monuments on which calibration is based.

5.1 Monument condition change and local authority area

As each of the main local authority areas represented in the study area has been subject to differing levels of archaeological input within the planning process, an attempt to identify variations in monument preservation between local authority areas has been made. The results produced are examined briefly here. As outlined in chapter 3, most of the sample monuments are in Perth and Kinross, which contains some 67% of the sample (521 monuments). Fife (134 monuments, 17%) accounts for the second largest monument group according to local authority area, while Angus contains 98 (13%) of the monuments in the sample. Dundee, Stirling and Clackmannan contain eight, 17 and one sample monuments respectively.

5.1.1 Uncalibrated condition change and local authority area

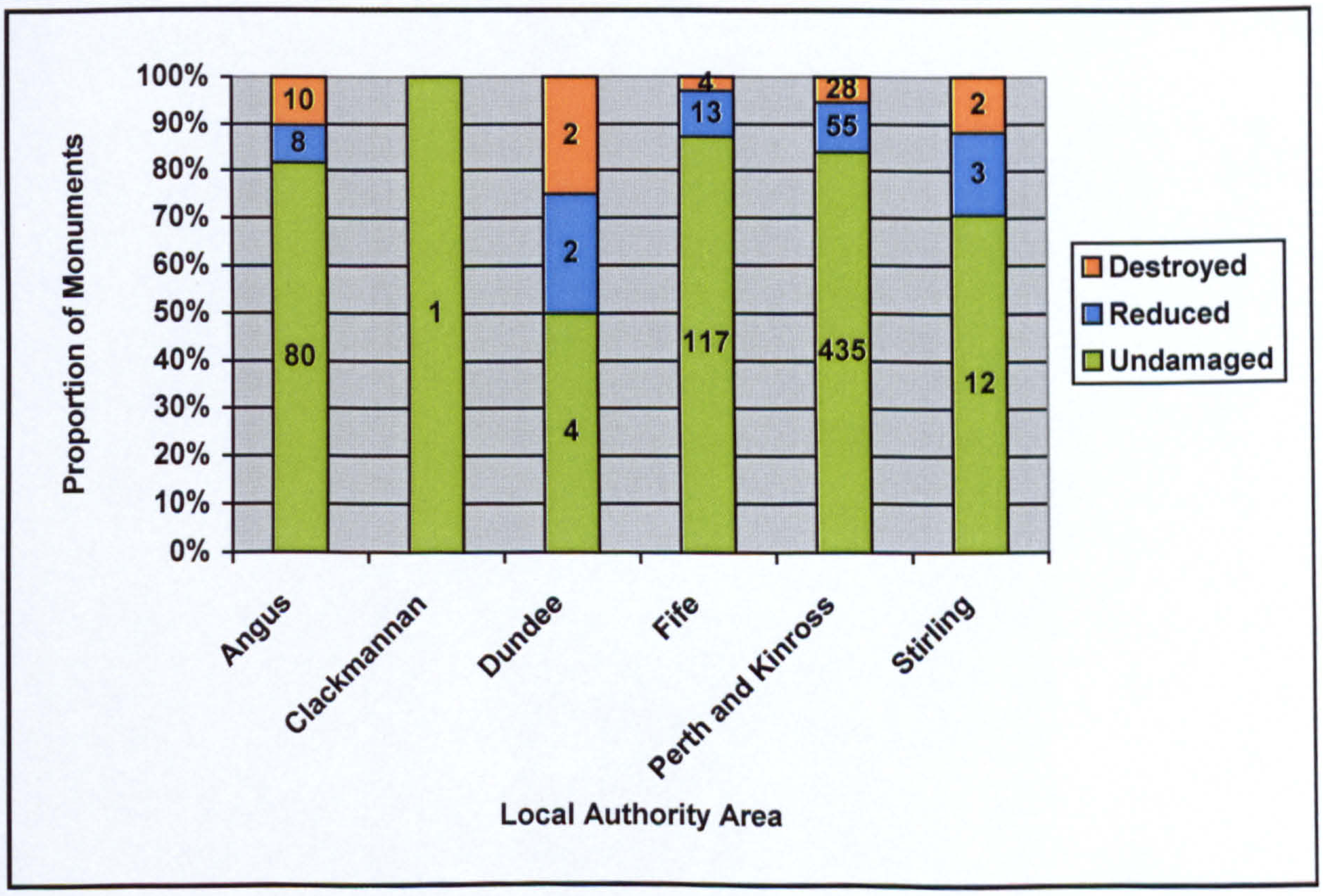

Fig 5.1. Uncalibrated numbers and percentages of sample monuments undamaged, reduced and destroyed according to local authority area.

Figure 5.1 shows numbers of sample monuments undamaged, reduced and destroyed within each of the local authority areas, and demonstrates that percentages of undamaged monuments within the three largest local authority areas are relatively constant, with between 82% and 87% of monuments undamaged. Within the smaller local authority areas, numbers of monuments examined are too small to enable an accurate assessment of actual monument loss rates, though the high levels of monument loss suggested (on the basis of only eight monuments) in Dundee are unsurprising, given the urban nature of the authority area.

5.1.2 Causes of damage identified through the desk-based study by local authority

The causes of damage and destruction identified through the desk-based study according to local authority are shown in table 5.1. Within any local authority area (Clackmannan is not included as no damage was noted here), each damage type is usually restricted to one or two examples. Cases of damage or destruction caused by excavation and development are noted in all five areas, while damage caused by farming operations is found in all areas except Stirling.

	Perth and Kinross		Fife		Angus		Stirling		Dundee		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	10	6	2		1	5				1	25
Development	6	4	2	1		2	1	1	1	1	19
Extraction		2	2			2					6
Forestry	7	3	1		1						12
Excavation	25	1	9		2		3				40
Building decay	2								1		3
Building renovation	2								1		3
Building re-utilisation	2		1				1				4
Demolition	1		1	1							3
Stone removal					1						1
Landscaping								1			1
Tree growth	2										2
Vandalism			1								1
Unknown	19	11	5	1	8	2			1		47
TOTAL	76	27	24	3	13	11	5	2	4	2	167

Table 5.1. Numbers of cases of damage (R) and destruction (D) recorded through desk-based study, according to local authority area.

As table 5.1 shows, most cases of damage have occurred within Perth and Kinross, but as the majority of sample monuments are in Perth and Kinross, this is to be expected. Some of the figures shown in table 5.1 are of interest, however. Firstly, recorded excavation damage appears to be high in Fife (accounting for a third of all damage and destruction) but is notably low in Angus, where only two cases have been recorded.

Secondly, recorded destruction caused by farming operations is relatively high in Angus. Of the eight damage cases of unknown cause in Angus, a further three are probably due to farming operations, suggesting that as many as a third of all damage cases recorded in Angus have been as a consequence of farming, mostly when ploughing has disturbed buried cists. By contrast, relatively few cases of farming-related damage have been recorded in Fife.

5.1.3 <u>Calibration of monument condition change and local authority area</u>

Figure 5.2 shows likely totals of monuments undamaged, reduced and destroyed within the complete sample of 779 monuments, after calibration. As outlined in chapter 4, calibration is based upon all 258 monument condition histories recorded during the accuracy assessment. Consequently, these figures provide a calibrated best-case scenario of monument condition change since 1850.

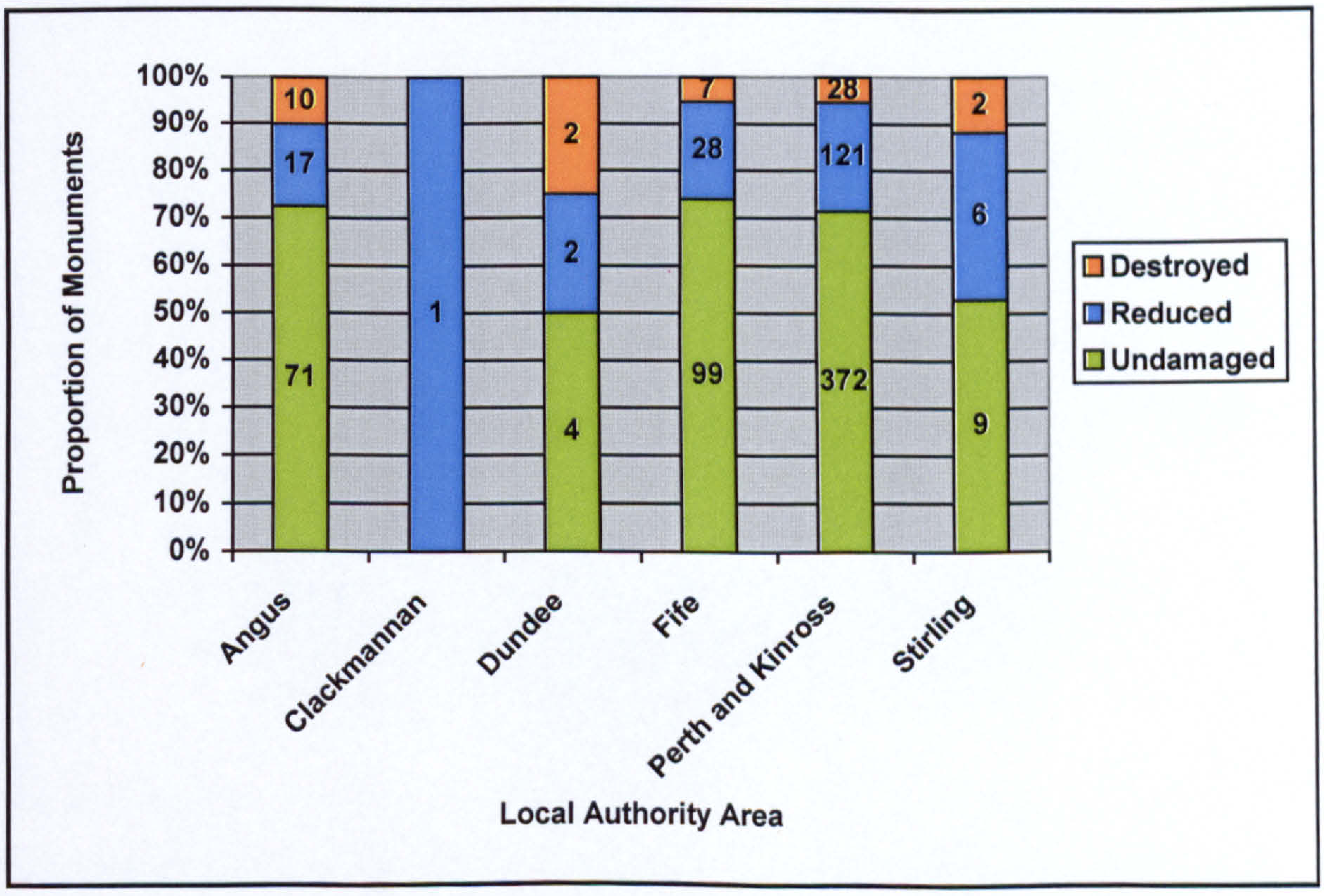

Figure 5.2. Calibrated numbers and percentages of monuments undamaged, reduced and destroyed according to local authority area.

As figure 5.2 shows, approximate percentages of undamaged monuments within the three largest local authority areas are similar (between 71 and 74%), although these figures are markedly lower than those suggested by the uncalibrated results. In Angus, about 10% of recorded monuments are destroyed, a proportion greater than that of monuments destroyed in Perth and Kinross and Fife (approximately 5% each). Within Stirling and Clackmannan, although proportions of monuments reduced and destroyed appear to be much higher, these figures cannot be trusted owing to the small numbers of monuments from these local authority areas (five and one respectively) included in the accuracy assessment. No monuments within Dundee authority area have been checked during the accuracy assessment. As a result, the proportions of monuments reduced and destroyed within Dundee are uncalibrated. While overall ratios of monuments undamaged, reduced and destroyed in the three largest Local Authority areas appear relatively uniform, condition change percentages vary greatly when the extant monuments are viewed in isolation from cropmarks and other buried features.

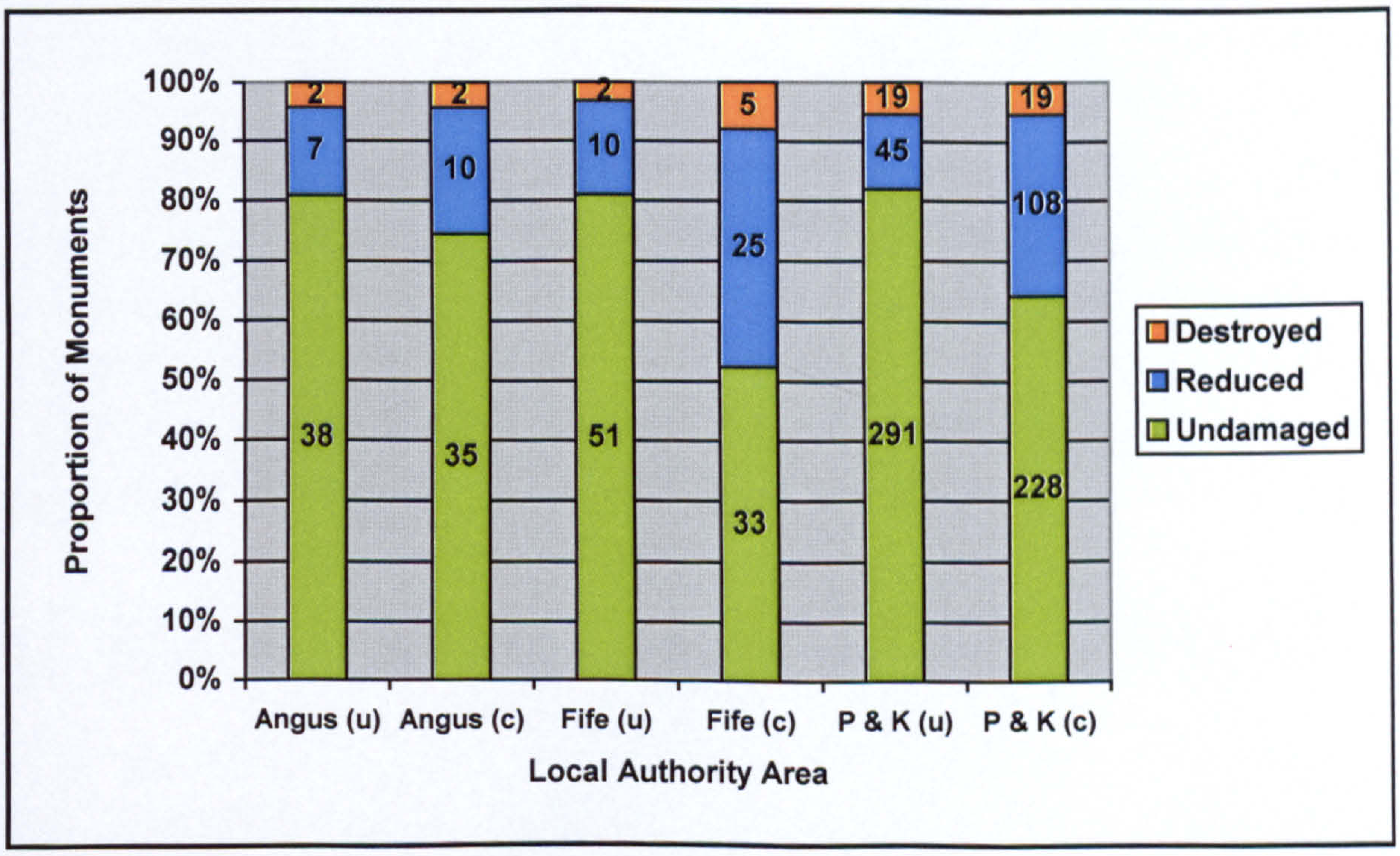

Figure 5.3. Uncalibrated (u) and calibrated (c) numbers and percentages of extant monuments undamaged, reduced and destroyed according to local authority area.

As figure 5.3 demonstrates, calibrated results show that extant monuments appear to have survived best in Angus and worst in Fife. Although few within any of the Local Authority areas have been destroyed, it notable that after calibration, only about half of recorded extant monuments in Fife appear to have escaped damage since 1850, a marked decrease on the uncalibrated figure of about 81%. That this figure is so high is probably due to the small number of extant monuments in Fife upon which condition calibration has been based. Of the 29 extant monuments in Fife included in the accuracy assessment, five recorded as undamaged by the desk-based study proved to be reduced, causing a marked difference between the uncalibrated and calibrated condition figures. Although even fewer extant monuments in Angus were included in the accuracy assessment (25 in total), only one identified as undamaged by the desk-based study was found to be reduced, and consequently, the difference between the calibrated and uncalibrated condition totals for extant monuments in Angus is much smaller. This serves to illustrate that when based upon small numbers of monuments, calibrated figures produced may be subject to inaccuracies. For this reason, calibrated totals of monuments undamaged, reduced and destroyed must be treated with caution, particularly when they have been produced using small datasets.

While the variations in monument condition change within Perth and Kinross, Fife and Angus shown in figure 5.3 are suggestive of differing rates of monument preservation across the study area, it would be misleading to attribute these variations to the presence or absence of a regional archaeologist. Almost all damage recorded through the desk-based study and accuracy assessment had taken place before regional archaeologists were appointed, and in the two recorded cases of development-related damage noted since the appointment of regional archaeologists in Fife and Stirling, both have been preceded by excavations. The variations in monument survival between local authority areas can be attributed to factors other than the presence or absence of a Regional Archaeologist, and are more likely to be related to environmental variables, as discussed later in this chapter.

5.1.4 Damage identified through the accuracy assessment: local authority area

Of the 258 monuments examined during the accuracy assessment, 180 are extant and 78 are cropmarks. It has been possible to identify 58 'new' cases of damage to these 258 monuments, none of which have been identified through the desk-based study. Numbers of damage cases identified through the desk-based study have not been calibrated in the manner that monument condition change has. However, examination of the damage cases identified through the accuracy assessment helps to illustrate shortcomings in the desk-based study as a means of identifying specific damage types, and provides an indication of damage types which may have been under-represented in the damage types suggested through the desk-based study. Of the 58 cases of damage and destruction identified through the accuracy assessment, 52 have been at extant monuments, while only six have been at cropmark monuments.

	Perth and Kinross		Fife		Angus		Stirling		Clackmannan		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	12		2	1					1		16
Development	3		1		3						7
Extraction					1						1
Forestry	15		3								18
Excavation					1						1
Building decay	1										1
Building renovation	2		1								3
Building re-utilisation			1								1
Stone removal	1										1
Landscaping	1										1
Tree growth	1										1
Windthrow	2						1				3
Vandalism	1										1
Earth Tremor	1										1
Unknown			1		1						2
TOTAL	40	0	9	1	6	0	1	0	1	0	58

Table 5.2. Numbers of cases of damage (R) and destruction (D) recorded through accuracy assessment according to local authority area.

Table 5.2 illustrates numbers of damage cases recorded at sample monuments through the accuracy assessment, and shows that significant damage has occurred at sample monuments which has not been identified through the desk-based study. At monuments in Angus, most of the damage cases recorded have occurred through development or mineral extraction. By contrast, in Perth and Kinross and Fife, cases identified are dominated by damage incurred through farming and forestry operations, particularly in Perth and Kinross. It would be dangerous to read too much into these figures, and, as with the calibrated monument condition figures, misleading to suggest that the variations in types of damage cases recorded are as a direct result of the presence or absence of Regional Archaeologists. The variations in damage types between Local Authority areas almost certainly owe more to local environmental conditions than to the authority area in which a monument is found. For example, forestry damage will only occur where forestry is present, and as the bulk of commercial forestry in the study area is located in Perth and Kinross, it is no surprise that cases of recorded forestry damage are highest here also.

5.1.5 Summary of monument condition change and local authority area

From the data sources used, it has not been possible to identify variations in monument survival that can be attributed to the presence or absence of a Regional Archaeologist. Variations in monument survival rates appear to exist between the three largest Local Authority areas represented, particularly when examining results produced through the accuracy assessment and calibration exercise. Given the small numbers of monuments on which condition calibration in Fife and Angus is based, however, it is difficult to be confident of the calibrated results produced. If nothing else, the examination of monument condition change by Local Authority shows that survival rates are not uniform across the study area. It is unquestionable that certain variables have contributed to the observed differences in monument survival between Local Authority areas, but on the basis of the desk-based study and accuracy assessment, it seems highly unlikely that Local Authority area itself is one such variable.

5.2 Condition change and monument period

The census (chapter 3) has identified patterns in monument distribution according to the period of monument construction and use. Although some of these patterns are likely to reflect genuine archaeological distributions, it is inevitable that some of the observed distribution patterns will also reflect biases in survival and recording. One of the objectives of this part of the desk-based study has been to identify any recent trends in monument loss which might help account further for observed patterns in monument distribution according to period.

5.2.1 Uncalibrated condition change and monument period

Figure 5.4 shows uncalibrated proportions of sample monuments undamaged, reduced and destroyed in by 1999, according to monument period.

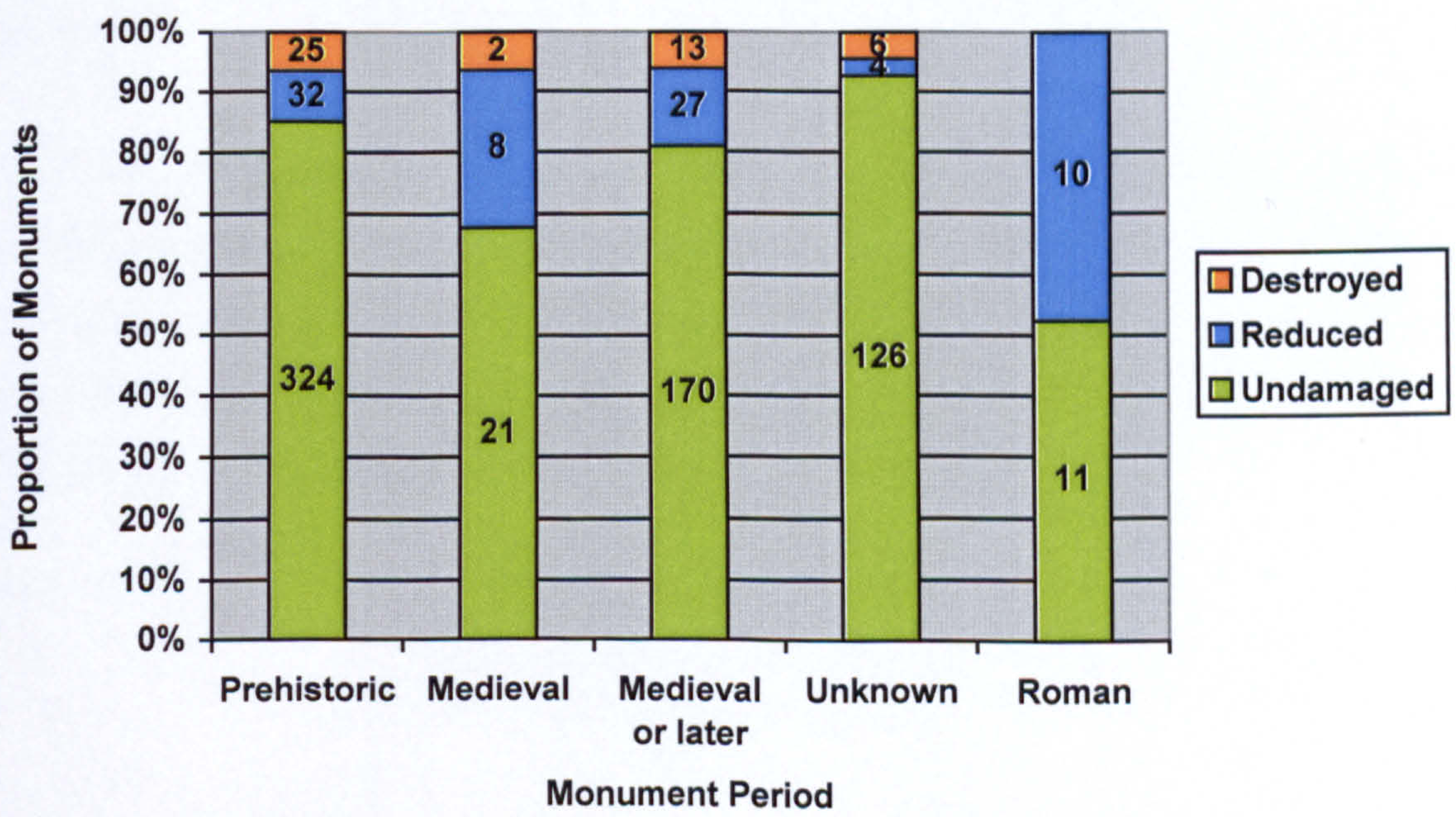

Figure 5.4. Uncalibrated numbers and percentages of sample monuments undamaged, reduced and destroyed according to monument period.

As figure 5.4 demonstrates, about 85% of prehistoric monuments and about 81% of monuments of medieval or later date appear to have survived undamaged to 1999. By contrast, damage rates among medieval monuments and Roman monuments appear to be significantly higher, with only about 68% of medieval monuments and 52% of Roman monuments surviving undamaged to 1999, while monuments of unknown date have survived best, with only about 10% reduced or destroyed. The patterns illustrated in figure 5.4 are potentially misleading, however, as much of the variation can be attributed to biases in the dataset on which the desk-based study is based. For example, prehistoric monuments appear to have survived well, but only about half of the prehistoric monuments in the sample are extant. Few cropmark monuments have any written description in the NMRS, and all such monuments are recorded as undamaged by the desk-based study. Conversely, the majority of cists in the sample have been recorded only during destruction, which may have caused an over-representation of destroyed prehistoric monuments in figure 5.4. Most Roman monuments in the study area have been subject to archaeological excavation in the last 70 years, causing the low proportion of undamaged Roman monuments seen in figure 5.4. Monuments of unknown date appear to have been subject to the least damage of any of the period groups represented. This is due to a combination of two factors. Firstly, few have been subject to archaeological excavation (otherwise their period of construction and use would probably be known), and secondly, the majority of monuments of unknown date are cropmarks with no written NMRS description, so identification of damage at such monuments has been impossible through the desk-based study.

By removing all cropmarks (for which recorded loss is probably under-representative of actual loss) and buried monuments (for which recorded loss is significantly higher than actual loss) from analysis, a different pattern of monument loss since 1850 emerges. Figure 5.5 shows proportions of extant monuments undamaged, reduced and destroyed since 1850, as identified through the desk-based study.

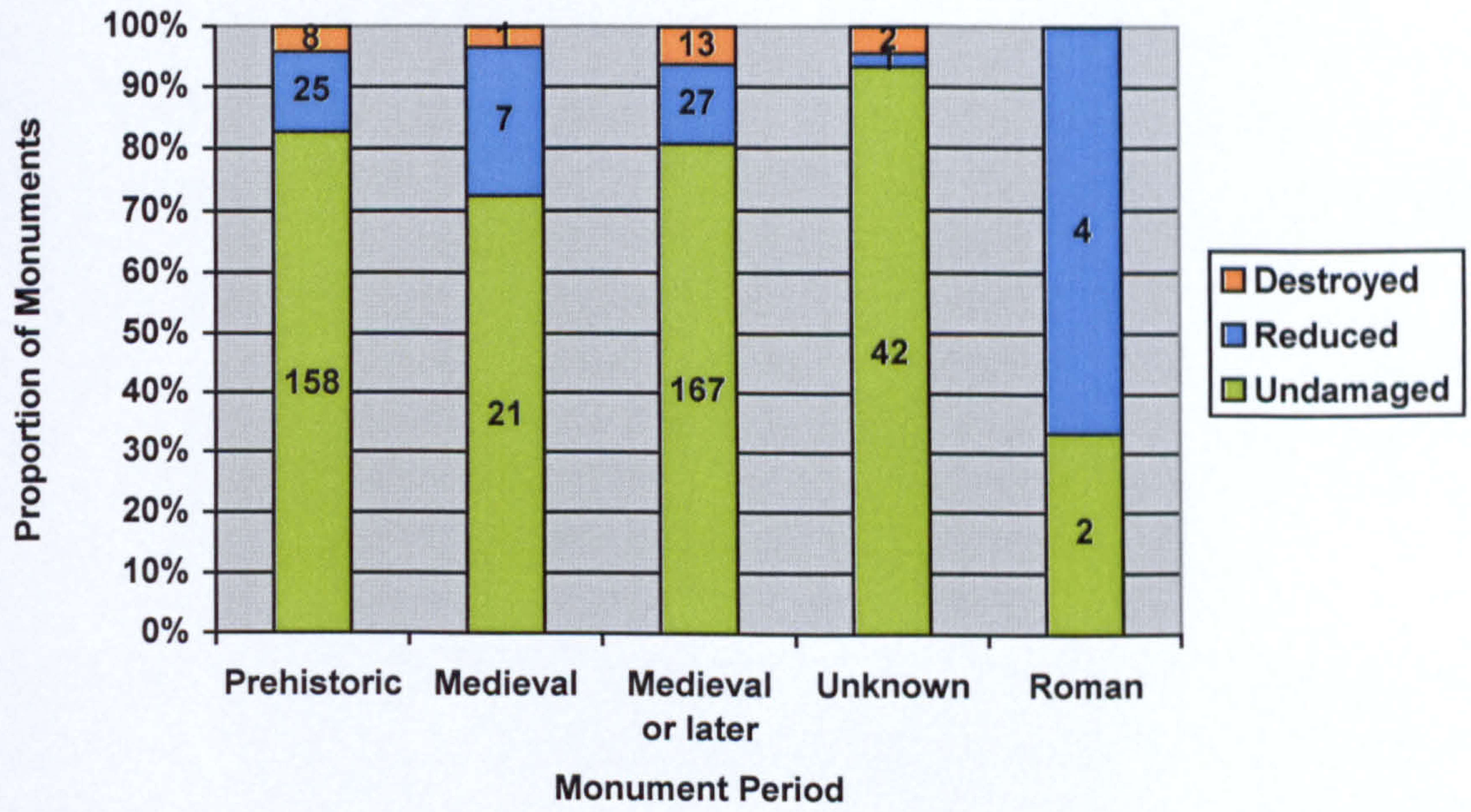

Figure 5.5. Uncalibrated numbers and proportions of extant sample monuments undamaged, reduced and destroyed by monument period.

As figure 5.5 shows, with cropmarks and buried monuments excluded from analysis, the number of prehistoric monuments destroyed drops significantly (owing to the exclusion of cists), but this change aside, overall proportions of undamaged extant monuments remain largely in keeping with those identified for all sample monuments. The single notable exception is among Roman monuments, where the proportion of undamaged Roman monuments drops from 52% to 33%, though this figure is based on a group of six monuments only.

5.2.2 Calibrated condition change and monument period

Figure 5.6 shows totals of monuments undamaged, reduced and destroyed within the total sample of 779 monuments after calibration, which is based upon the data recorded during the accuracy assessment of 258 monuments. These figures provide a calibrated best-case scenario of monument condition change since 1850.

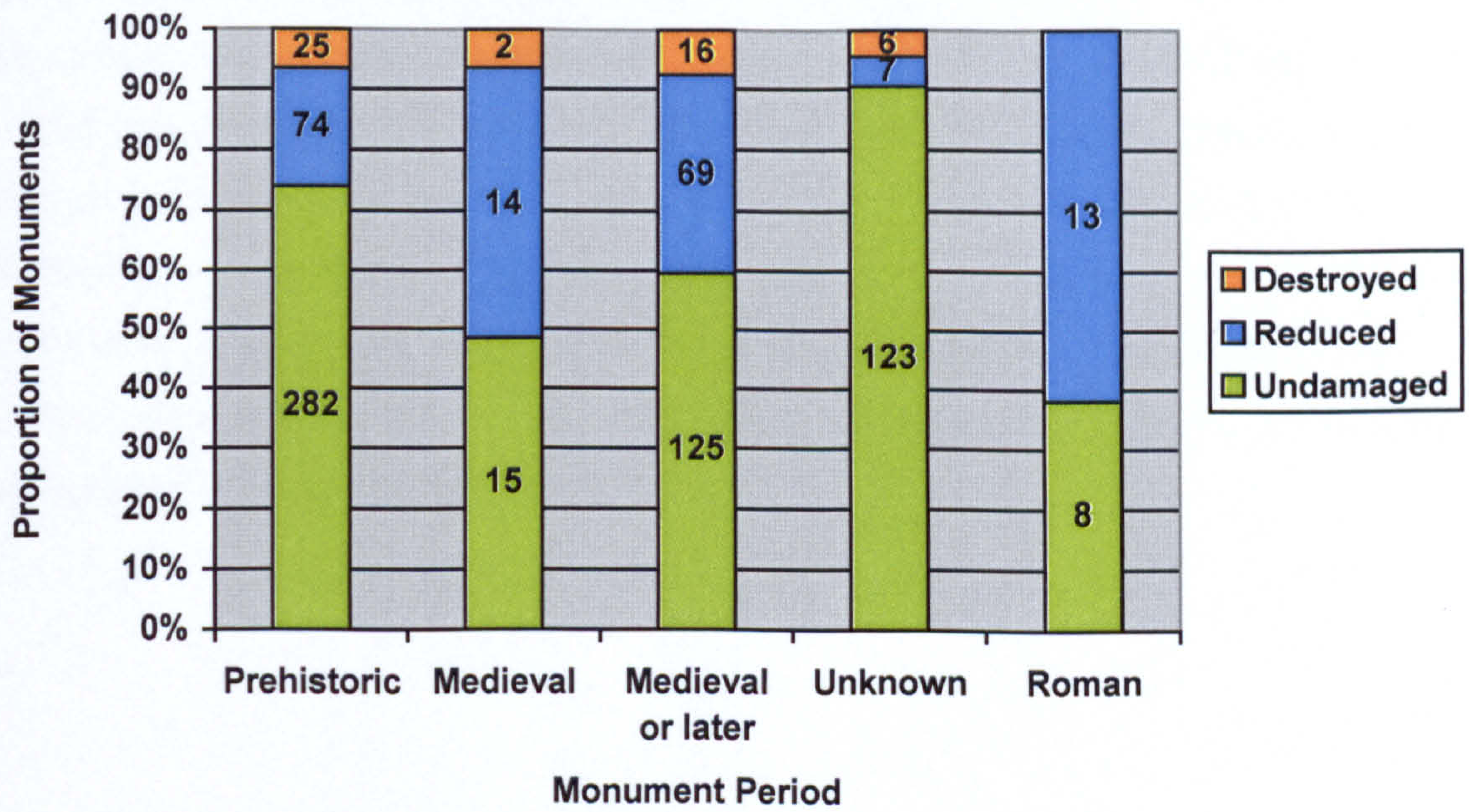

Figure 5.6. Calibrated numbers and proportions of monuments undamaged, reduced and destroyed according to period.

As figure 5.6 shows, within all period groups, levels of recorded damage are increased after calibration. The calibrated condition figures serve to accentuate some of the patterns noted in the uncalibrated results, as well as reflecting trends already observed in chapter 4. For example, cropmark prehistoric monuments survive better than extant prehistoric monuments do, with 92% of cropmark prehistoric monuments undamaged, compared with only 65% of extant prehistoric monuments. This trend can be observed across the entire sample, and reflects the difficulties noted in chapter 4 in identifying condition change at cropmarks monuments. Only about half of monuments of medieval date survive undamaged since 1999, but again, this confirms a trend noted previously, namely that as most of the medieval monuments in the sample are standing buildings with a long history of recording, deterioration is easy to detect.

Although monuments of medieval or later date appear relatively undamaged according to the uncalibrated results, after calibration, this group of monuments appears to have been subject to a much greater level of damage than hitherto suggested, with only 59% undamaged since 1850. As with the medieval monuments, most of these are standing buildings, but unlike the medieval monuments, few have a detailed written description in the NMRS, so damage is certainly under-represented in the uncalibrated figures. For the majority of these monuments, the accuracy assessment has provided the only data by which to assess condition change, and because many are standing structures, it is not surprising that many have been reduced. Although most of the Roman monuments in the sample are recorded as reduced in extent since 1850, it is encouraging to note that none have been destroyed in this time. As identified previously, nearly all damage at Roman monuments is through archaeological excavation. Finally, even after calibration of monument condition totals, monuments of unknown period appear to have survived best. Again, however, this can be attributed at least in part to the difficulties experienced in identifying damage to cropmark monuments, which make up the majority of monuments of unknown date.

5.2.3 Monument period and damage identified through the desk-based study

	Prehistoric		Medieval		Medieval or Later		Unknown		Roman		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	6	9	1	1	5		1	2			25
Development	3	5	1	1	3	1	1	2	2		19
Extraction	2	4									6
Forestry	8	1			1	2					12
Excavation	18	1	5		3		1		12		40
Building decay					3						3
Building renovation			2		1						3
Building re-utilisation			1		3						4
Demolition					2	1					3
Stone removal	1										1
Landscaping								1			1
Tree growth	1				1						2
Vandalism					1						1
Unknown	14	5	4		14	8	1	1			47
TOTAL	53	25	14	2	37	12	4	6	14	0	167

Table 5.3. Numbers of cases of damage (R) and destruction (D) recorded through the desk-based study, according to monument period.

Depending on monument period, types of damage noted at sample monuments vary. As shown in table 5.3, the main cause of damage to prehistoric monuments has been excavation, with farming operations being responsible for a large proportion of monument destruction. Development and mineral extraction have also accounted for several cases of damage and destruction at prehistoric monuments, though as with destruction caused by farming operations, many of the monuments destroyed are negative features such as cists. Of the 19 damage cases through unknown causes shown in table 5.3, seven are probably through farming operations, with mineral extraction being the likely cause of a further three cases. The majority of forestry-related damage to prehistoric monuments has occurred in upland settings and within the last 30 years.

At monuments of medieval date, the most commonly identified cause of damage is again archaeological excavation, accounting for five of the 14 damage cases identified. Damage caused by the renovation and re-utilisation of standing structures is also evident, while farming operations and development have accounted for two cases of monument loss each. At monuments of medieval or later date, meanwhile, no single damage type dominates and 22 of the 49 cases of monument loss are through unknown causes. Of these 22, five of the monuments destroyed are likely to have been removed in order to increase the area of cultivatable land within arable fields. A further ten of the damage cases are probably attributable to natural building decay, and two cases of destruction and three cases of damage are likely to have been caused by stone removal.

At sample monuments of unknown date, only two of the ten damage or destruction cases have been recorded at extant monuments. The remainder have been recorded at buried features (four cases) and cropmarks (four cases). Because of the nature of the monuments making up the group, development and agriculture are the main causes of damage. Table 5.3 shows that excavation has accounted for nearly all damage to Roman monuments in the sample, although much of this has been very limited and exploratory in nature. The two cases of development damage have both occurred at Roman Temporary Camps, at Edenwood (NMRS number NO31SE 39) and Hillside, Dunblane (NMRS number NN70SE 11). At both, excavations have taken place prior to development.

5.2.4 Monument period and damage identified through the accuracy assessment

The 58 cases of further monument damage noted during the accuracy assessment have been found in monuments of all periods, as shown in table 5.4.

	Prehistoric		Medieval		Medieval or Later		Unknown		Roman		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	4		1		10	1					16
Development	5		1		1						7
Extraction	1										1
Forestry	9				5		1		3		18
Excavation	1										1
Building decay			1								1
Building renovation	1		1		1						3
Building re-utilisation					1						1
Stone removal					1						1
Landscaping									1		1
Tree growth	1										1
Windthrow	1		1		1						3
Vandalism					1						1
Earth Tremor					1						1
Unknown					2						2
TOTAL	23	0	5	0	24	1	1	0	4	0	58

Table 5.4. Numbers of cases of damage (R) and destruction (D) recorded through the accuracy assessment, according to monument period.

While the figures shown in table 5.4 confirm the presence of many of the damage types noted through the desk-based study, they also provide a better indication of the frequency of damage types at monuments of various periods. For example, contrary to the results of the desk-based study, which suggest that the most significant cause of loss at prehistoric monuments is archaeological excavation, the accuracy assessment suggests that loss of prehistoric monuments through excavation is less significant than loss through farming, development and forestry. Of the 29 cases of damage or destruction at prehistoric monuments noted through the accuracy assessment, 18 have been through farming, development or forestry, while archaeological excavation has accounted for only one case. At monuments of medieval or later date, the accuracy assessment has shown again that damage through farming operations is likely to have been greater than suggested by the desk-based study, with 11 of 25 damage cases attributable to farming compared with only five of 49 recorded through the desk-based study.

5.2.5 Summary of condition change and monument period

Although the analysis above shows variations in monument condition change according to monument period, it is difficult to demonstrate that the loss recorded has been caused as a result of monument period, with two exceptions. The first case where damage is directly attributable to monument period is archaeological excavation, which has occurred mostly at Roman, prehistoric and medieval monuments. Excavation at these monuments has occurred because it is monuments of these periods which have held archaeological interest for longest. In addition to archaeological excavation as a process of damage attributable to monument period, several of the sample monuments of medieval and post-medieval date have been reduced since 1850 through renovation, re-utilisation or natural building decay. That damage of this type since 1850 has been recorded exclusively at medieval and post-medieval monuments is due to their relatively good state of preservation when compared with monuments of prehistoric date, which is directly attributable to the date at which they were constructed. Evidence of building re-utilisation in prehistory is not uncommon at stone-built prehistoric monuments, and so the renovation and re-utilisation of medieval and post-medieval structures merely reflects the continuation of a long-established practice. Because renovation or re-utilisation will only take place at a building which is largely upstanding and structurally sound, however, it will only have occurred within the last 150 years at standing buildings, namely those of medieval or post-medieval date.

These two examples aside, it is likely that variations in levels of loss between monument period groups identified through the desk-based study can be attributed more to disparities in the levels of information held within the NMRS for each of the period groups or to other variables. For example, the desk-based study records abundant damage to prehistoric and medieval sites because the NMRS generally records such sites in some detail. By contrast, very little damage is recorded through the desk-based study at monuments of post-medieval or unknown date because they are mostly cropmarks or monuments with very little NMRS description. Although the accuracy assessment shows that damage at monuments of all periods is higher than suggested through the desk-based study, this increase in damage recorded is most pronounced at post-medieval monuments, illustrating that disparities in levels of condition information in the NMRS have been significant in determining levels of damage recorded through the desk-based study.

5.3 Monument condition change and elevation

In chapter 3, it was noted that although numbers of sample monuments diminish with altitude, a number of zones appear to exist within which densities of recorded monuments are markedly lower than might be expected, particularly between 100m and 200m OD and, to a lesser extent, between 200m and 250m OD. The causes of this negative information zone are not clear, although the relative lack of cropmark formation and recording in arable and improved land above 100m OD is likely to be a contributing factor.

5.3.1 Uncalibrated monument condition change and elevation

To assess the extent to which the abundance or paucity of monuments at certain altitudes might indeed be attributable to patterns of monument survival and destruction, condition change among sample monuments has been examined in relation to altitude. Uncalibrated totals of monuments undamaged, reduced and destroyed are shown in figure 5.7.

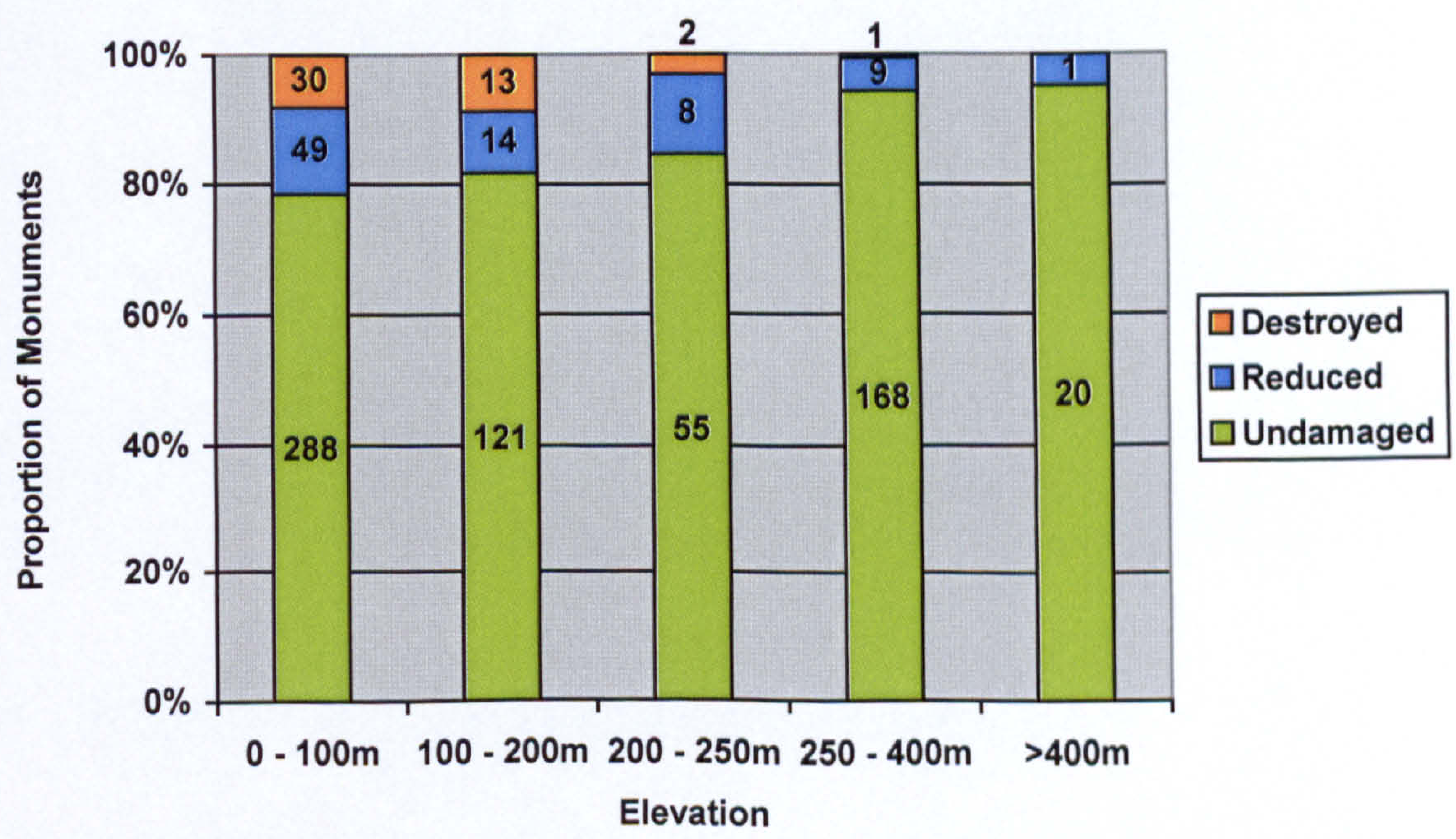

Figure 5.7. Uncalibrated numbers and proportions of sample monuments undamaged, reduced and destroyed according to elevation.

As figure 5.7 shows, uncalibrated recorded monument loss is greatest at low altitudes, with about 79% of monuments undamaged between 0m and 100m OD, 82% undamaged between 100m and 200m OD, and about 85% undamaged between 200m and 250m OD. By contrast, about 94% of monuments remain undamaged between

250m and 400m OD, while 95% remain undamaged above 400m OD. As previously noted, however, damage to cropmark monuments is difficult to detect, and as nearly 60% of the monuments recorded below 100m OD are cropmarks, the figures shown in figure 5.7 probably do not represent actual damage figures accurately. Excluding all buried monuments (cropmarks and buried features like cists) from analysis, the disparity in recorded monument loss between low and high altitudes is even more pronounced, as shown in figure 5.8. With buried monuments removed from analysis, the proportion of undamaged monuments below 100m OD drops to only about 61%, while proportions of monuments undamaged above 250m OD remain unchanged at 94% and 95% respectively.

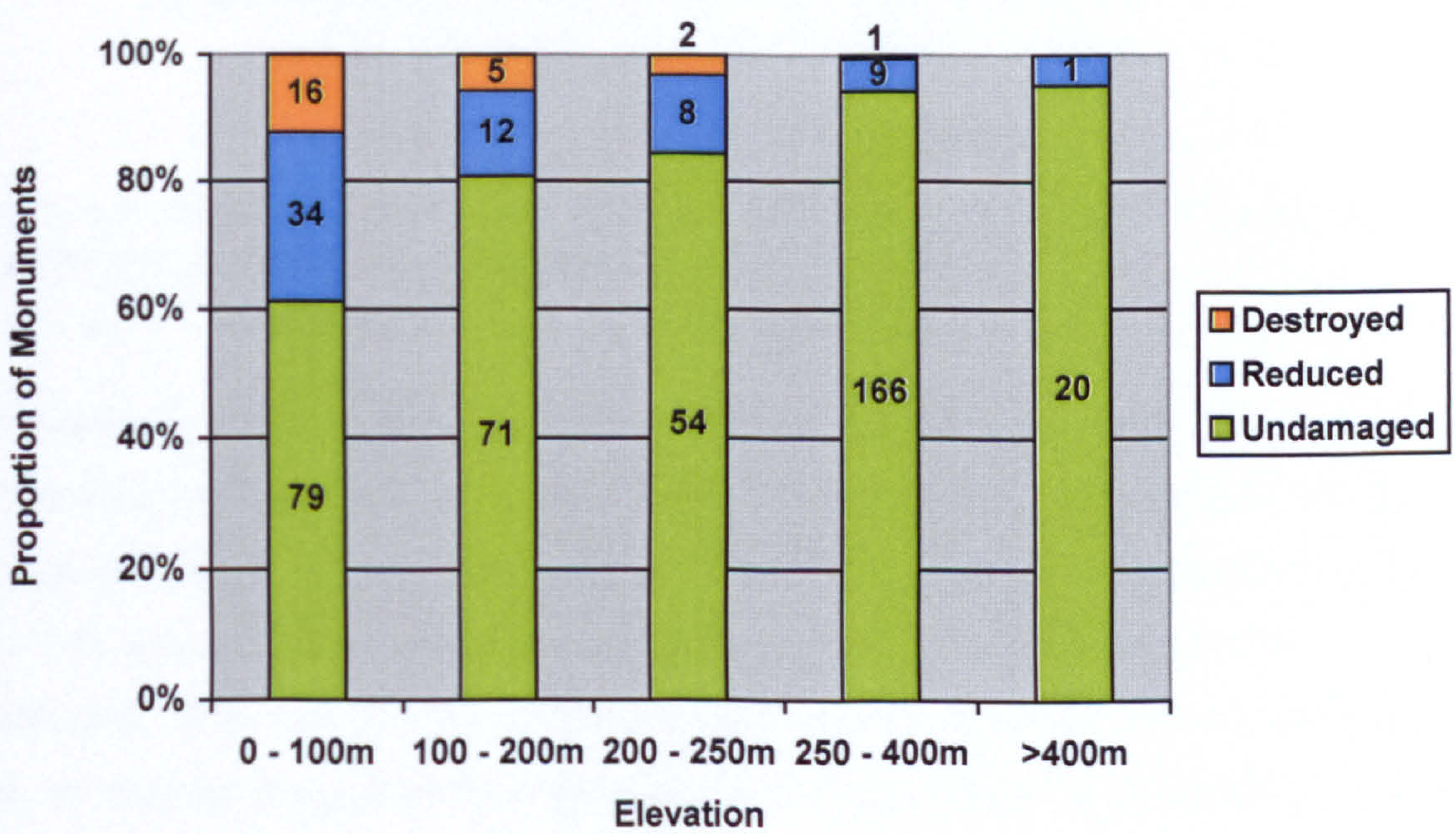

Figure 5.8. Uncalibrated numbers and proportions of extant sample monuments undamaged, reduced and destroyed according to elevation.

5.3.2 Calibrated monument condition change and elevation

Calibration of the figures from the desk-based study using the data recorded through the accuracy assessment shows that although monument loss at low altitudes is greater than the desk-based study suggests, considerable damage has occurred at higher altitudes, very little of which has been identified through the desk-based study alone.

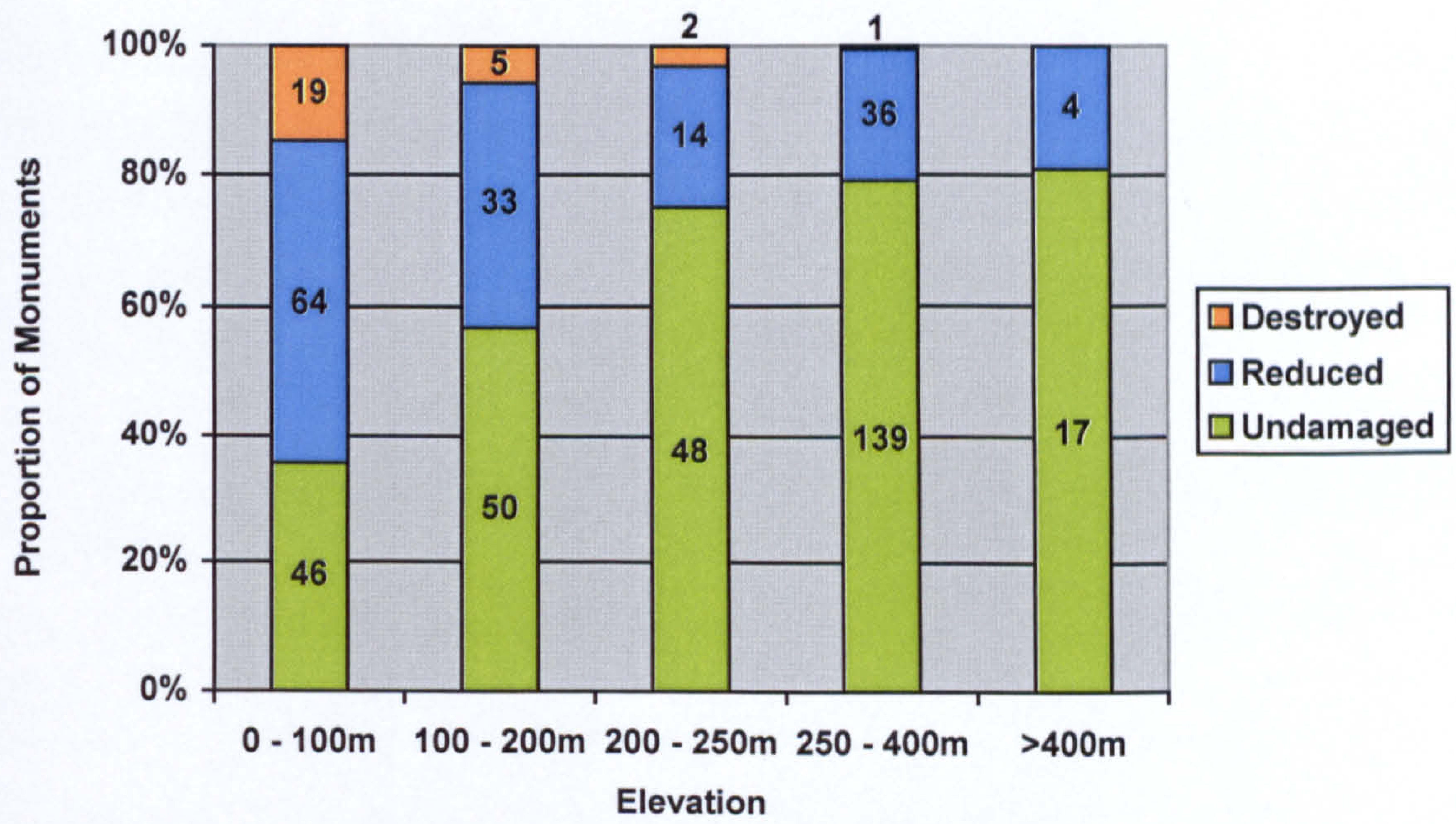

Figure 5.9. Calibrated numbers and proportions of extant sample monuments undamaged, reduced and destroyed according to elevation.

As shown in figure 5.9, calibration of the figures from the desk-based study shows that among extant monuments, only about 36% of those situated below 100m OD have no damage recorded, with about 50% reduced and 15% destroyed. Between 100m and 200m OD, extant monuments have survived slightly better, with about 57% undamaged, 38% reduced and about 6% destroyed. In both of these elevation bands, calibrated figures show a marked increase in damage from the uncalibrated figures. The smallest increase in damage shown in the calibrated figures is among monuments found between 200m and 250m, where about 75% are recorded as undamaged, with about 22% reduced and 3% destroyed. It is among monuments situated above 250m OD that the most surprising figures emerge following calibration. According to the uncalibrated results of the desk-based study, about 95% of these monuments have survived undamaged since 1850, yet according to the calibrated figures, this total is likely to be closer to 80%.

5.3.3 Elevation and causes of damage

The causes of monument loss recorded according to elevation are shown in table 5.5. To help illustrate the types of damage recorded through the desk-based study and the accuracy assessment, and how these damage cases have affected calibrated totals of monument condition, damage recorded through both the desk-based study and accuracy assessment is shown in the same table.

	Damage identified through desk-based study										**Damage identified through accuracy assessment**										
	0-100m		100-200m		200-250m		250-400m		> 400m		0-100m		100-200m		200-250m		250-400m		> 400m		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	**TOTAL**
Farming	10	6	3	5		1					4	1	7		2		2				**41**
Development	7	7	2	2	1						6						1				**26**
Extraction	2	2		2							1										**7**
Forestry	1	2	5				3	1			5		4		2		6		1		**30**
Excavation	27	1	5		4		3				1										**41**
Building decay	3												1								**4**
Building renovation	2		1								1		2								**6**
Building re-utilisation	3								1		1										**5**
Demolition	2	1																			**3**
Stone removal					1								1								**2**
Landscaping		1									1										**2**
Tree growth	1		1														1				**3**
Windthrow											2						1				**3**
Vandalism	1										1										**2**
Earth Tremor											1										**1**
Unknown	22	9	4	4	4	1	3				1		1								**49**
TOTAL	**81**	**29**	**21**	**13**	**10**	**2**	**9**	**1**	**1**		**25**	**1**	**16**		**4**		**11**		**1**		**225**

Table 5.5. Causes of damage (R) and destruction (D) noted through desk-based study and accuracy assessment according to elevation.

As table 5.5 shows, monument loss recorded through the desk-based study is concentrated among monuments situated below 100m OD (110 cases from a population of 367 monuments, or 0.3 cases per monument) and between 100m and 200m OD (34 cases from a population of 148 monuments, or 0.23 cases per monument). At higher altitudes, recorded damage has been less frequent. Among the 178 monuments recorded between 250m and 400m OD, only ten cases have been recorded (0.06 cases per monument), and among the 21 monuments situated above 400m OD, the desk-based study has recorded only one case of damage or destruction (0.05 cases per monument). According to the results of the desk-based study, the causes of monument loss are diverse at low altitudes, but above 250m OD, forestry, archaeological excavation and unknown causes make up ten of the eleven cases of monument damage or destruction identified.

Although the accuracy assessment has confirmed some of the trends in damage noted through the desk-based study, it shows that monument loss attributable to farming and forestry is greater than suggested by the desk-based study, particularly at higher altitudes. As table 5.5 shows, more forestry damage has been recorded through the accuracy assessment than through the desk-based study. The eighteen cases of forestry damage have been recorded from a population of 258 monuments, compared with the 12 cases identified from 779 monuments in the desk-based study. Forestry damage recorded through the accuracy assessment falls into two categories. First, cases where monuments have been recorded in forestry by the desk-based study but where damage had not been noted, and secondly, monuments where land use had changed since the last dated NMRS description, and the new forestry had caused damage. Damage recorded through the accuracy assessment which is attributable to farming operations is also more pronounced at higher altitudes than the desk-based study has suggested. Above 150m OD, however, the majority of farming-related damage recorded is through tracks, vehicle damage, stock poaching and drainage (figure 5.10), whereas the farming related damage at low altitudes recorded through the desk-based study is mostly related to arable farming.

Figure 5.10. Drainage cut through an area of otherwise well-preserved rig and furrow in Perthshire. Monument name and location withheld.

5.3.4 Summary of monument condition change and elevation

In summary, it can be seen that there is a strong relationship between monument loss and elevation, although the causes of loss vary between elevation bands. Loss at low altitudes has been considerable, and has been caused primarily by arable farming, archaeological excavation and development, while loss at higher altitudes has been dominated by forestry and non-arable farming. While the census (chapter 3) has shown a relative paucity of recorded monuments between about 100m and 200m OD, it is difficult to identify any trends in monument loss since 1850 that might help explain this. If one accepts that the paucity of monuments within this altitude band is attributable at least in part to the removal of extant archaeological remains through improvements, it might be expected that the results of the desk-based study would show the removal of extant monuments though agriculture within this zone. This is not the case, however. A total of 21 cases of damage to or destruction of extant monuments between 100m and 200m have been recorded through the desk-based study, with a further 16 recorded through the accuracy assessment. Of these 37 cases, only eleven have been caused by farming-related activities, and none of these eleven cases has seen the destruction of a monument. It is impossible, therefore, to demonstrate that a pronounced loss of monuments attributable to agricultural improvements since 1850 has occurred within the study area between 100m and 200m OD.

Barclay (1992b) has argued that improved pasture and marginal arable land constitutes a zone where afforestation might destroy unrecorded archaeological deposits where improvements have removed extant remains but where cropmarks have not been recorded. The low density of recorded monuments in the zone from about 100m to about 250m OD suggests that this may indeed be the case. It is, however, this lack of recorded monuments between 100m and 250m OD which makes the argument difficult to prove or disprove. Unrecorded archaeological remains cannot be quantified, and consequently, neither can their loss.

5.4 Monument condition change and Land Capability for Agriculture

Although Land Capability for Agriculture (LCA) classification summarises the suitability of land for a variety of agricultural purposes, it also provides a useful measure by which the general characteristics of the land can be assessed. By examining the distribution of extant and cropmark sample monuments according to the LCA classification (chapter 3) it has been possible to identify general trends in long-term monument preservation in relation to these general land characteristics. For example, about 58% of sample monuments situated in land with an LCA classification of 2 or 3 have only ever been recorded as cropmarks, implying that at least half of recorded monuments in these areas had been levelled by 1850. By contrast, only five of the 249 sample monuments located in land with an LCA classification of 5, 6 or 7 are cropmarks, with the remainder recorded only as extant remains. Land with an LCA classification of 4 appears to constitute a negative information zone. As noted in chapter 3, the density of recorded monuments in land with an LCA classification of 4 is less than in among monuments situated in land with an LCA classification of 2, 3 and 5. This relative paucity can probably be explained by the lack of cropmarks within this LCA category (12% of monuments), despite the LCS88 recording about 60% of land in this LCA category as being arable or improved.

5.4.1 Uncalibrated monument condition change and LCA

The census has suggested that the majority of extant monuments in good agricultural land were levelled before 1850, and examination of monument loss since 1850 reinforces this pattern of high rates of damage among monuments in better agricultural land. Figure 5.11 shows uncalibrated numbers of monuments undamaged, reduced and destroyed according to LCA classification, and illustrates that monuments in LCA Class 3 land appear to have fared worst since 1850, with about 77% undamaged since 1850. By contrast, according to the uncalibrated results of the desk-based study, approximately 94% of monuments situated in Class 6 land have remained undamaged since 1850.

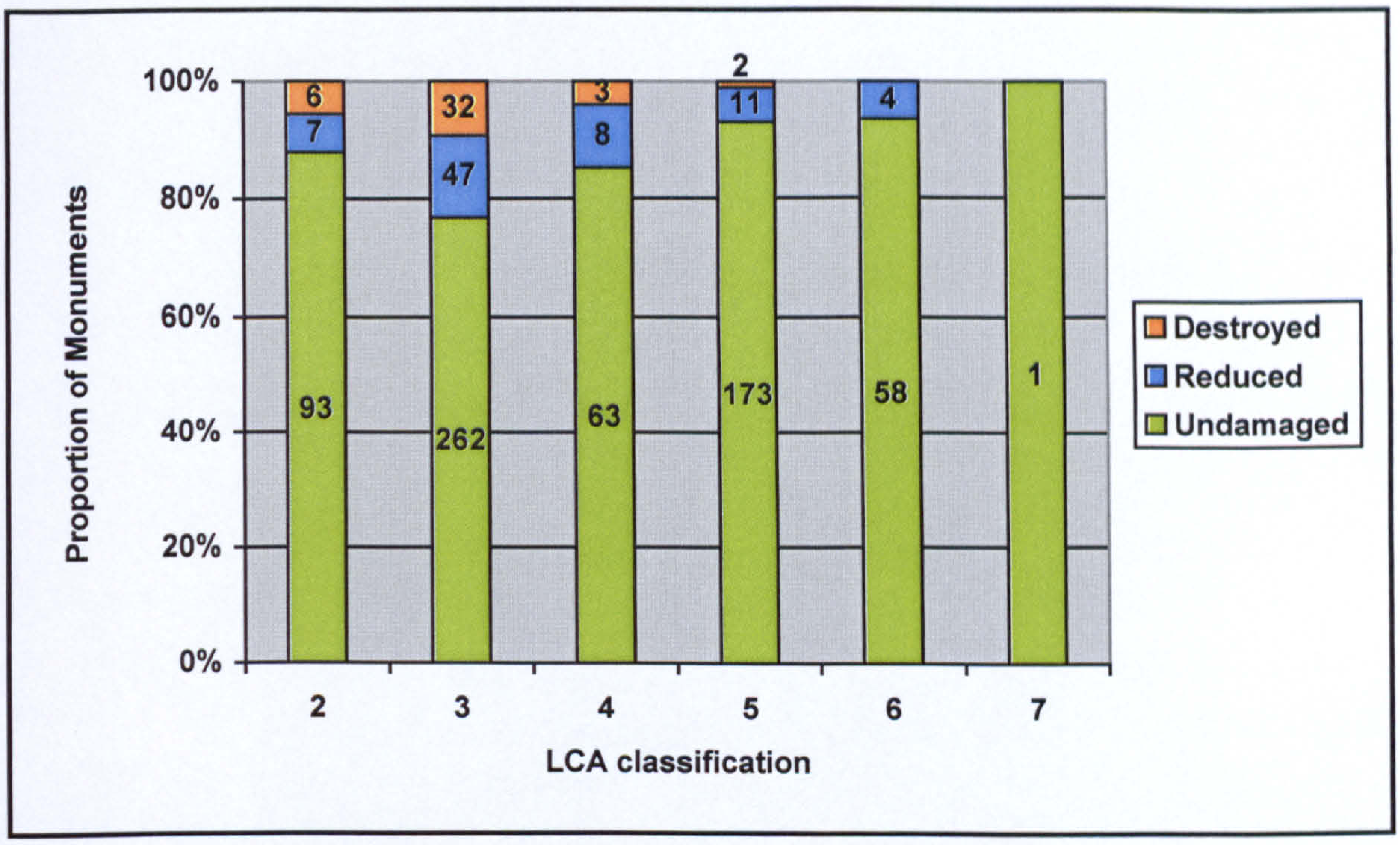

Figure 5.11. Uncalibrated numbers and proportions of monuments undamaged, reduced and destroyed according to LCA classification.

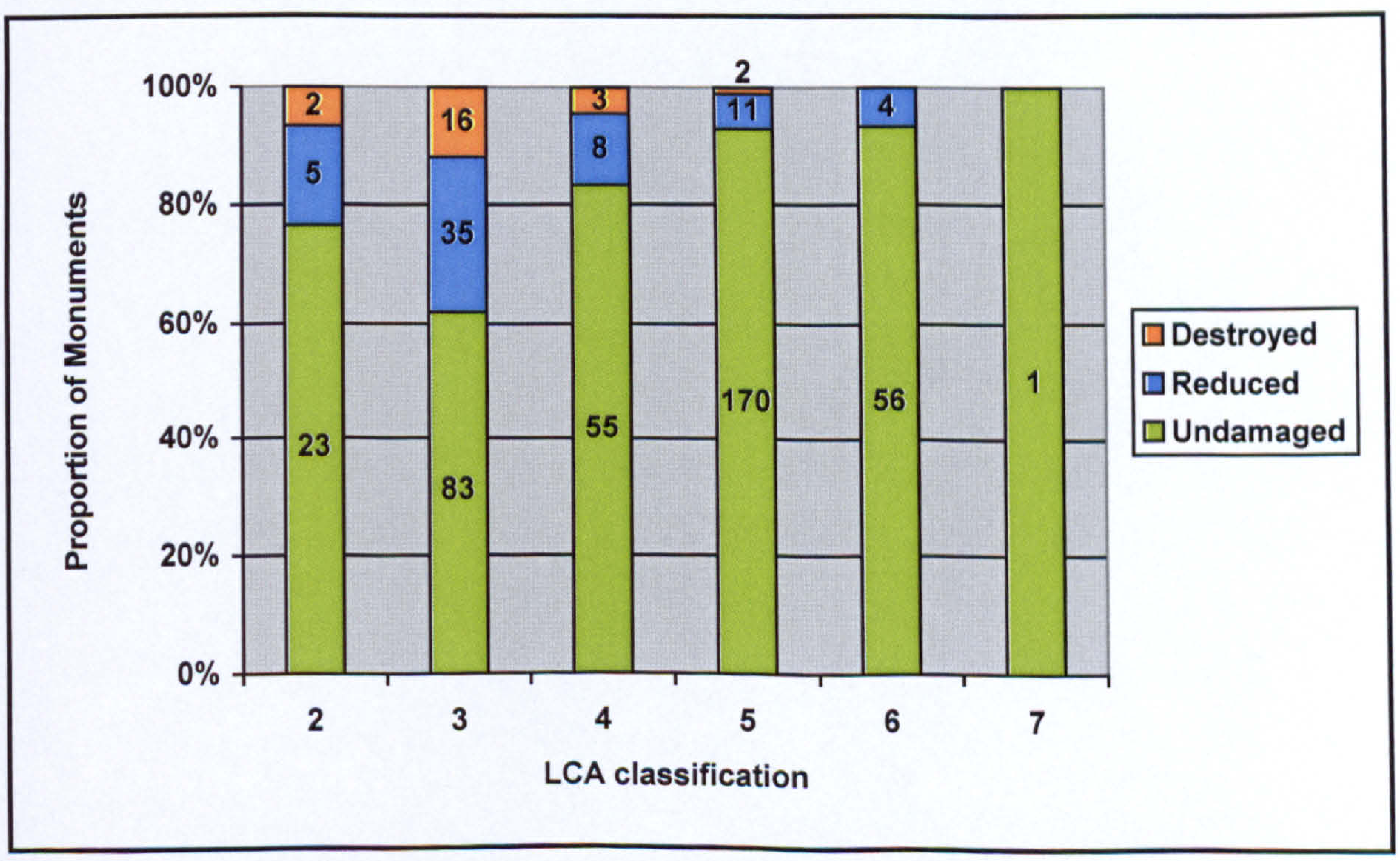

Figure 5.12. Uncalibrated numbers and proportions of extant monuments undamaged, reduced and destroyed according to LCA classification.

Among extant monuments, the differences in monument loss between LCA classifications are even more pronounced, as shown in figure 5.12. Only about 62% of extant monuments in LCA Class 3 land have remained undamaged since 1850, compared with about 93% undamaged in LCA Classes 5 and 6.

Calibration of the desk-based study results for all 779 sample monuments using the results of the accuracy assessment demonstrates an increase in recorded monument loss within all LCA classes.

5.4.2 Calibrated monument condition change and LCA

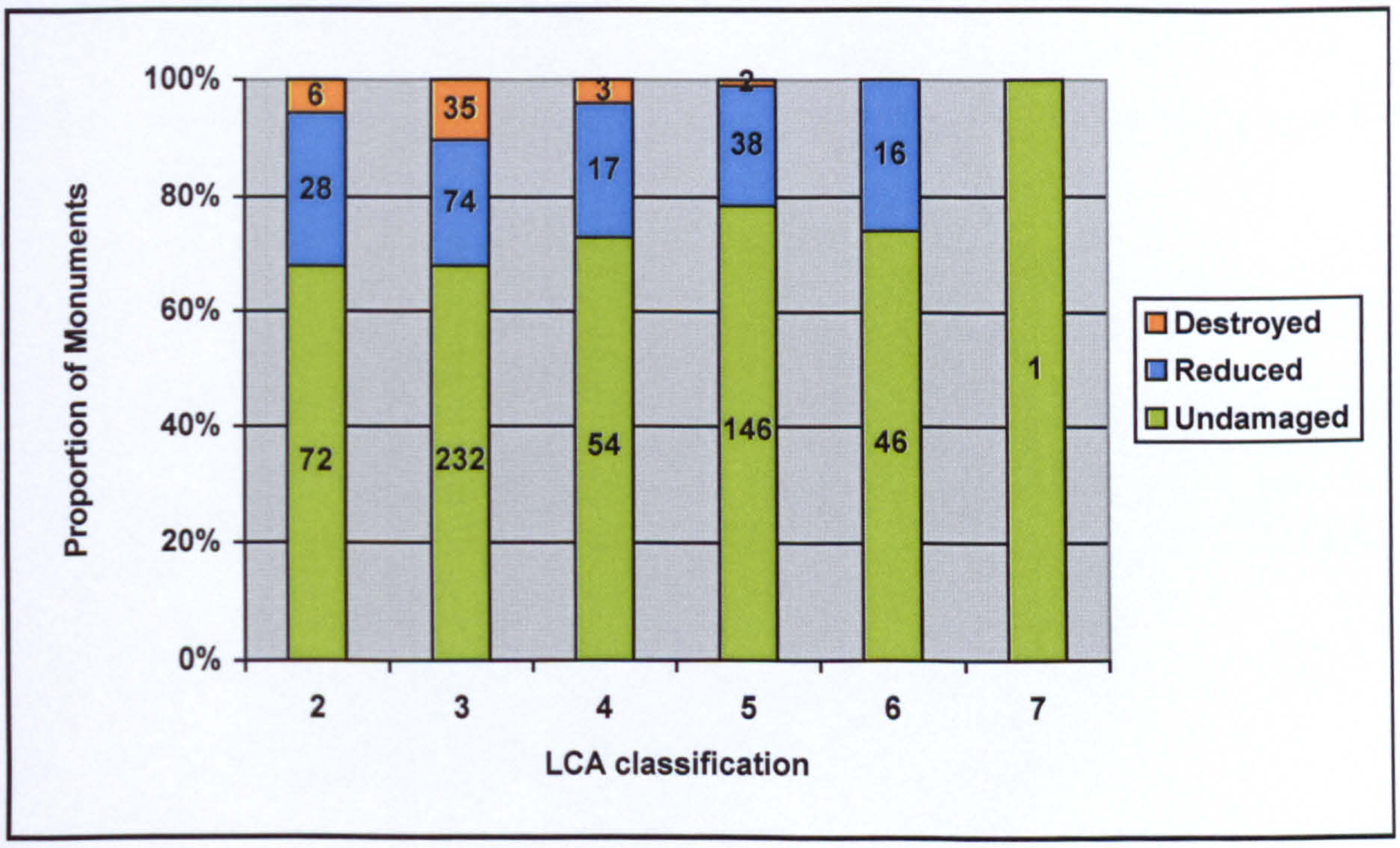

Figure 5.13. Calibrated numbers and proportions of sample monuments undamaged, reduced and destroyed according to LCA classification.

Figure 5.13 shows that as might be expected, calibrated levels of monument loss since 1850 are greatest among monument situated in land with an LCA classification of 2 and 3, and lowest among monuments situated in land with an LCA classification of 5 and 6. Despite having the lowest calibrated rates of monument loss, the levels of loss noted among monuments situated in land with an LCA classification of 5 and 6 are significantly higher than those demonstrated in the uncalibrated totals. The main reason for this is the large quantity of forestry related damage recorded in these areas through the accuracy assessment, although it should be noted that non-arable farming damage such as stock poaching and vehicle damage has contributed to this increase also (section 5.4.3).

Figure 5.13 shows calibrated totals of all sample monuments, but as the majority of monuments found in LCA Class 2 and 3 land are cropmarks, at which condition change is seldom discernable, figure 5.13 presents a biased view of monument loss. By contrast, figure 5.14 shows calibrated rates of monument loss among extant sample monuments only. Among extant sample monuments, calibrated figures suggest that fewer than 40% in LCA Class 2 and 3 land have survived undamaged since 1850. Among extant monuments situated in land with an LCA classification of 4, 5 or 6, however, the situation is significantly healthier, with between 70% and 80% recorded as undamaged, even after calibration.

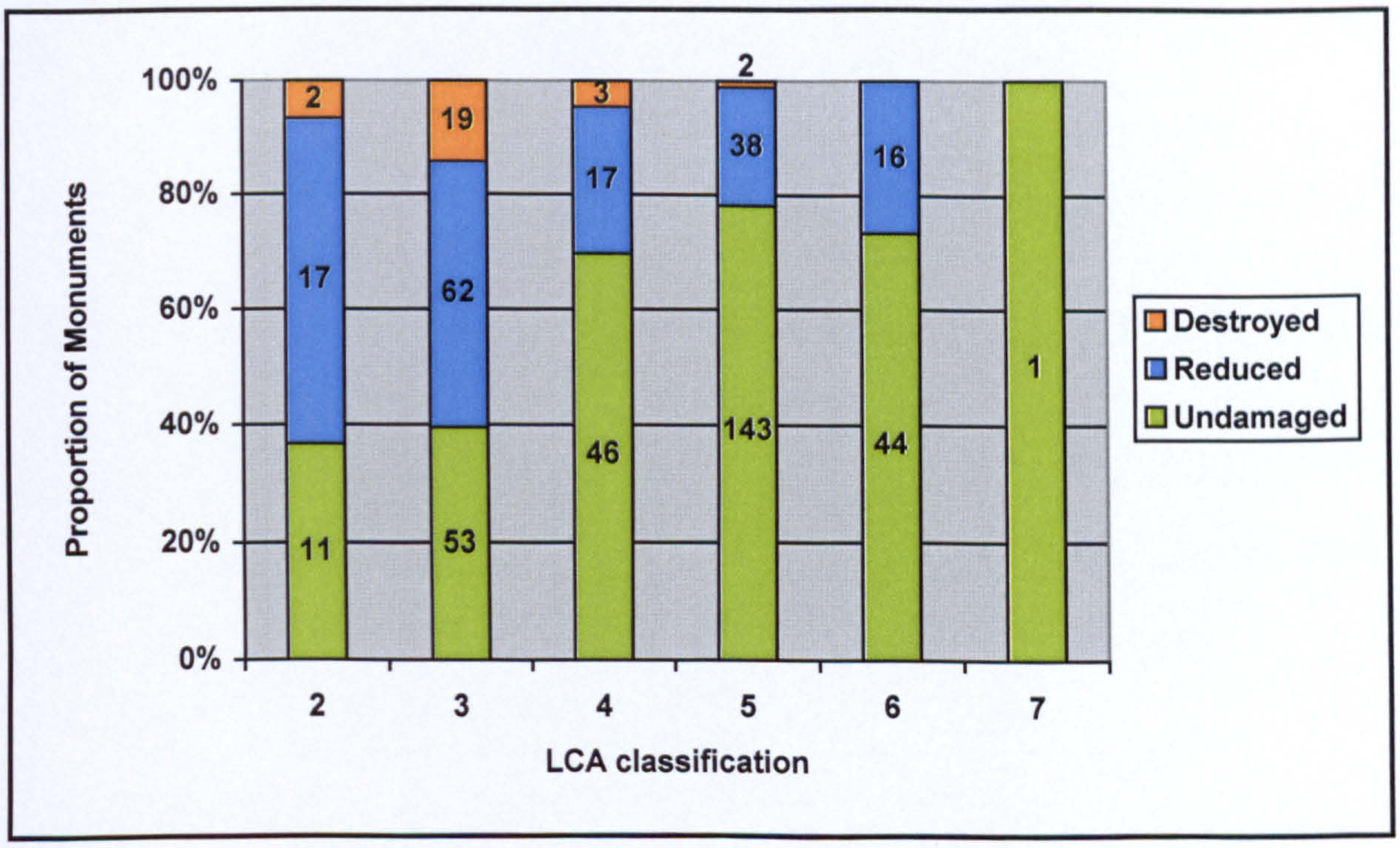

Figure 5.14. Calibrated numbers and proportions of extant sample monuments undamaged, reduced and destroyed according to LCA classification.

It should be remembered that the figures shown in figure 5.14 are best-case scenario results, and that actual rates of loss are likely to be higher than figure 5.14 suggests. It is worth noting also that although damage to extant monuments is greatest in Class 2 and 3 land, this is where the fewest extant monuments are found. In LCA Class 2 land, there are 106 monuments recorded. Of these, only 30 have been recorded as extant since 1850, and of these 30 monuments, according to the calibrated best-case scenario results, only about ten have survived undamaged since 1850. In short, only about 10% of the monuments recorded in LCA Class 2 land are extant and undamaged. As this figure of 10% is a best-case scenario, the actual figure is likely to be lower. In LCA Class 3 land, a similar picture emerges.

As figure 5.15 shows, of the 341 monuments recorded in LCA Class 3 land, only 134 have been recorded as extant since 1850. Of these 134, calibrated results show that only about 53 have remained undamaged since 1850. This suggests that as a best-case scenario, only about 16% of sample monuments are extant and undamaged since 1850. By contrast, calibrated results suggest that about 62% of sample monuments in LCA Class 4 land, 77% in LCA Class 5 and approximately 71% in LCA Class 6 land are extant and undamaged since 1850. Again, these figures present best-case scenarios, and actual rates of loss are likely to be higher.

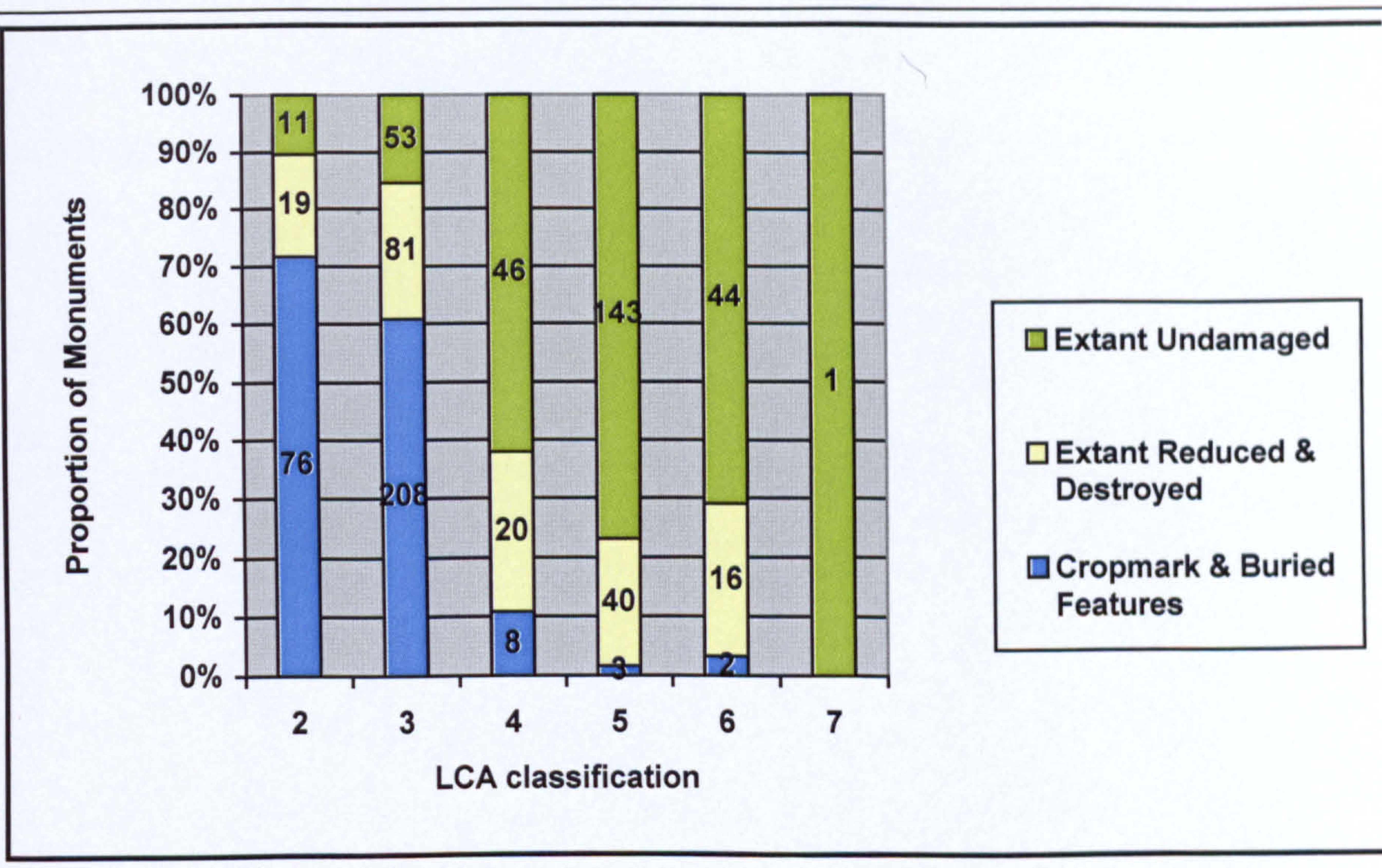

Figure 5.15. Numbers and proportions of extant sample monuments against numbers and proportions of cropmarks and buried features, by LCA classification.

It would be misleading to suggest that the high levels of monument loss in LCA 2 and 3 land are due solely to farming. While examination of LCA in relation to monument condition change might suggest that damage is highest where agricultural productivity is highest, many of the damage types identified are not farming-related. For example, through the desk-based study, no agricultural damage has been recorded among monuments situated in Class 2 land, though 25 cases have been identified in Class 3 land, with a further 5 cases of probable farming-related damage. Development, mineral extraction and archaeological excavation have played a substantial part in the damage recorded, among monuments in LCA Class 2 and 3 land, with forestry damage being most pronounced at monuments in LCA Class 5 land.

5.4.3 LCA and causes of damage identified through the desk-based study

	Class 2		Class 3		Class 4		Class 5		Class 6		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming			13	10				1			24
Development		2	4	5	1	1	1				14
Extraction		1	2	3							6
Forestry			1	2	1		6	1	1		12
Excavation	5		26	1	4		2		1		39
Building decay			2								2
Building renovation			2								2
Building re-utilisation			3						1		4
Demolition			1	1	1						3
Stone removal			1								1
Landscaping						1					1
Tree growth	1		1								2
Vandalism			1								1
Unknown	4	3	21	10	3	1	4		1		47
TOTAL	10	6	78	32	10	3	13	2	4	0	158

Table 5.6. Numbers of recorded cases of monument damage (R) and destruction (D) noted through the desk-based study, according to LCA classification.

Table 5.6 shows damage types recorded through the desk-based study, and suggests that agricultural damage has not played a significant role in monument loss within any LCA Class areas except LCA Class 3. Only one of the 24 cases of loss through farming operations has been recorded at a monument situated outwith LCA Class 3 land. The damage statistics collected through the accuracy assessment (table 5.7) present a different situation, however. Through the accuracy assessment, farming-related damage has been recorded at monuments in all LCA classes except LCA Class 4.

5.4.4 LCA and causes of damage identified through the accuracy assessment

	Class 2		Class 3		Class 4		Class 5		Class 6		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	2		2	1			10		1		16
Development	3		3				1				7
Extraction			1								1
Forestry	1		7		1		5		4		18
Excavation	1										1
Building decay			1								1
Building renovation	1		2								3
Building re-utilisation			1								1
Stone removal							1				1
Landscaping			1								1
Tree growth									1		1
Windthrow	1		1		1						3
Vandalism			1								1
Earth Tremor					1						1
Unknown			2								2
TOTAL	9	0	22	1	3	0	17	0	6	0	58

Table 5.7. Numbers of recorded cases of monument damage (R) and destruction (D) noted through the accuracy assessment, according to LCA classification.

Surprisingly, farming-related damage recorded through the accuracy assessment is most pronounced in Class 5 land, with 10 cases of 17 recorded being attributable to farming. Of these 10, one is through plough damage, one through dumped stone altering monument profile, with the remaining eight cases caused by vehicle damage (six cases), and cattle poaching (two cases). This helps illustrate the damage that can occur to monuments in less productive agricultural land, although the scale of damage inflicted by vehicles and tracks is usually more localised than would be found if the agent of damage were ploughing. As noted in section 4.5.3.6, poaching by cattle is potentially a very serious problem, particularly at earthwork monuments, and although it has been encountered only twice during the accuracy assessment, in both cases, it has caused very serious damage to the monuments in question.

As previously noted, a large amount of forestry-related damage has been recorded during the accuracy assessment. In LCA Class 5 and 6 land, this has been predominantly due to ploughing and planting in large-scale conifer plantations. Within the LCA Class 2 and 3 land, however, the forestry has been smaller in scale, with recorded damage occurring through vehicle movement, windthrow and drainage ditching.

5.4.5 Summary of monument condition change and Land Capability for Agriculture

In summary, it can be seen that although the calibrated results of the desk-based study suggest that monuments in better agricultural land (LCA classification of 2 or 3) have been subjected to the greatest levels of damage since 1850, within LCA Class 2 land, very little of this damage has been farming-related. In LCA Class 3 land, however, farming operations (or probable farming operations) have accounted for about a quarter of the damage recorded through the desk-based study. Among monuments situated in LCA Class 4, 5 and 6 land, levels of recorded monument loss are lower. The accuracy assessment has shown that forestry and farming operations have caused the majority of damage in these areas.

That recorded agricultural damage among sample monuments situated in LCA Class 2 land is less common than had been anticipated can probably be attributed to two factors. Firstly, of the 106 sample monuments in LCA Class 2 land, only 30 have been recorded as extant since 1850. Of the remaining 76 monuments recorded in LCA Class 2 land, 72 are cropmarks, at which damage (through inevitably occurring) is virtually impossible to record. Indeed, if it were possible to record damage at cropmark sites, it would not be unreasonable to suggest that most, if not all, would be recorded as reduced. Secondly, within the study area, about 20 of the 30 extant monuments found in land with an LCA classification of 2 are not sited within arable land, but are found in enclosures, field margins or small tracts of semi-natural woodland. As the majority of extant monuments recorded in LCA Class 2 land are removed from the pressures of agriculture, it is perhaps little surprise that levels of farming-related damage recorded through the desk-based study at these monuments are negligible.

Despite the unexpectedly low level of farming-related monument loss identified through the desk-based study, it is unquestionable that agriculture has played a major role in monument loss within the study area. Of the 447 sample monuments recorded in land with an LCA classification of 2 or 3, approximately 63% have only ever been recorded as cropmarks. Although some sample monuments will have been reduced to cropmarks since 1850, very few such cases have been recorded through the desk-based study and accuracy assessment, suggesting that in most cases, this process had taken place before 1850.

5.5 Monument construction type and condition change

While this chapter has examined a number of environmental variables that may have contributed to monument loss within the study area, it is important to assess the bearing that the material construction of a monument may have had on its survival. As the census (chapter 3) has shown, nearly half of the 779 sample monuments are primarily of stone construction, with only about 14% being of earthwork construction. Approximately 8% of sample monuments are negative features or cropmarks of monuments constructed as negative features, such as cists and souterrains. The remaining 31% of sample monuments are cropmarks of monuments constructed as extant features. As noted in chapter 4, among cropmarks and negative features, it is difficult to quantify condition change for a number of reasons. Among extant monuments, however, stone built monuments appear to survive much better than earthworks do, as stone built monuments outnumber earthworks by more than three to one. Among the cropmarks in the sample, however, it has been virtually impossible to demonstrate that any represent the remains of stone built monuments, suggesting that earthworks may be more vulnerable to damage through agricultural activities.

5.5.1 Uncalibrated condition change and monument construction type

Although the figures presented in chapter 3 may indicate trends in long-term survival of monuments depending on their material construction, through the desk-based study and accuracy assessment, it has been possible to assess whether or not monument construction material has had a bearing on rates of loss since 1850. Figure 5.16 (overleaf) shows proportions of monuments undamaged, reduced and destroyed, as identified through the desk-based study.

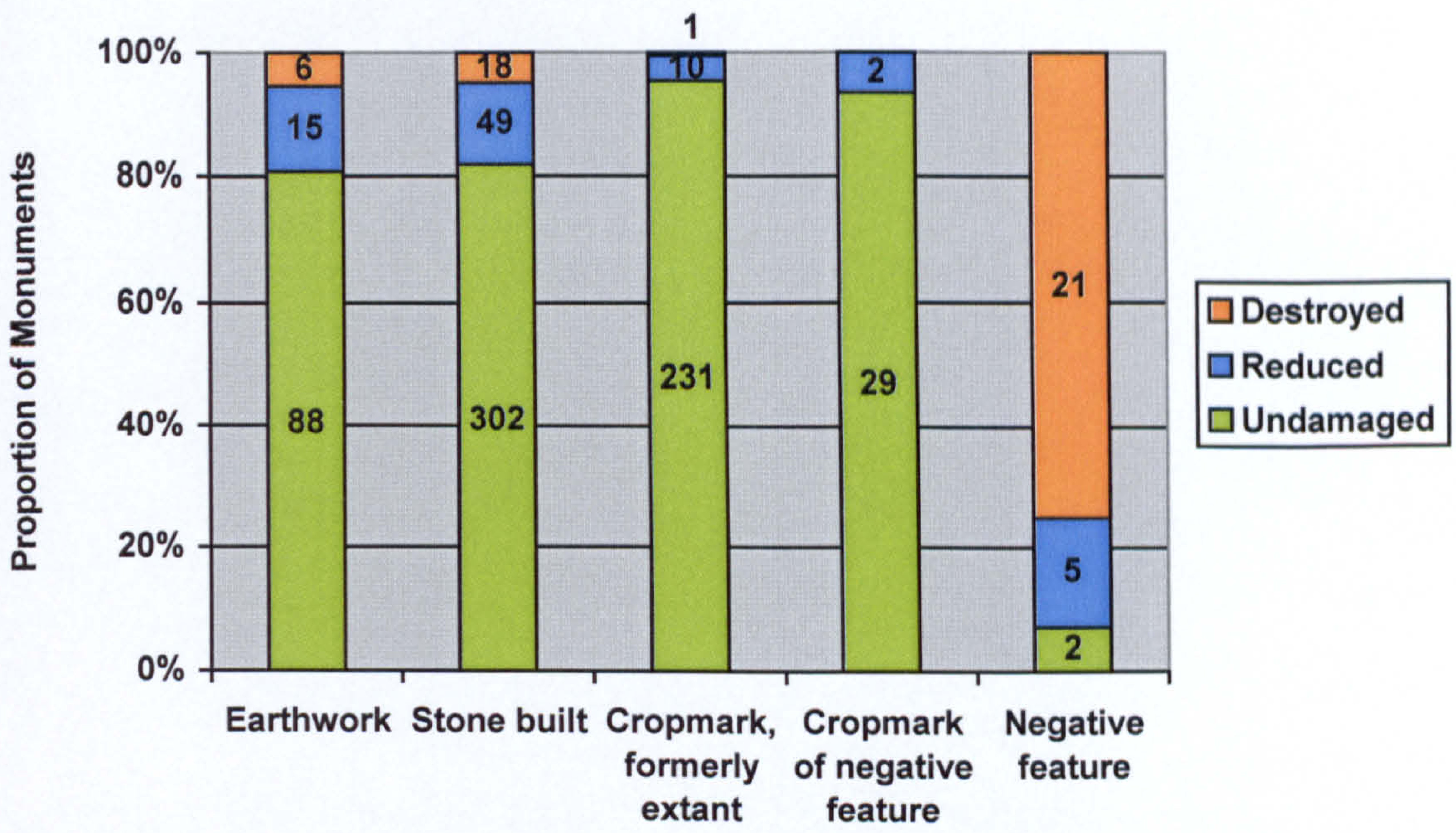

Figure 5.16. Uncalibrated numbers and proportions of sample monuments undamaged, reduced and destroyed according to construction type.

As figure 5.16 shows, cropmarks appear to have survived very well since 1850, while negative features have fared very badly. As discussed in chapter 4, however, loss figures for cropmarks and negative features are subject to a large number of biases and cannot be treated as reliable. Among extant monuments, the uncalibrated results suggest that rates of loss have been almost identical among both earthwork and stone built monuments, with about 81% undamaged, 14% reduced and 5% destroyed. By removing all those monuments from analysis for which there is no written NMRS description, however, slight variations become apparent in rates of loss between earthwork and stone built monuments.

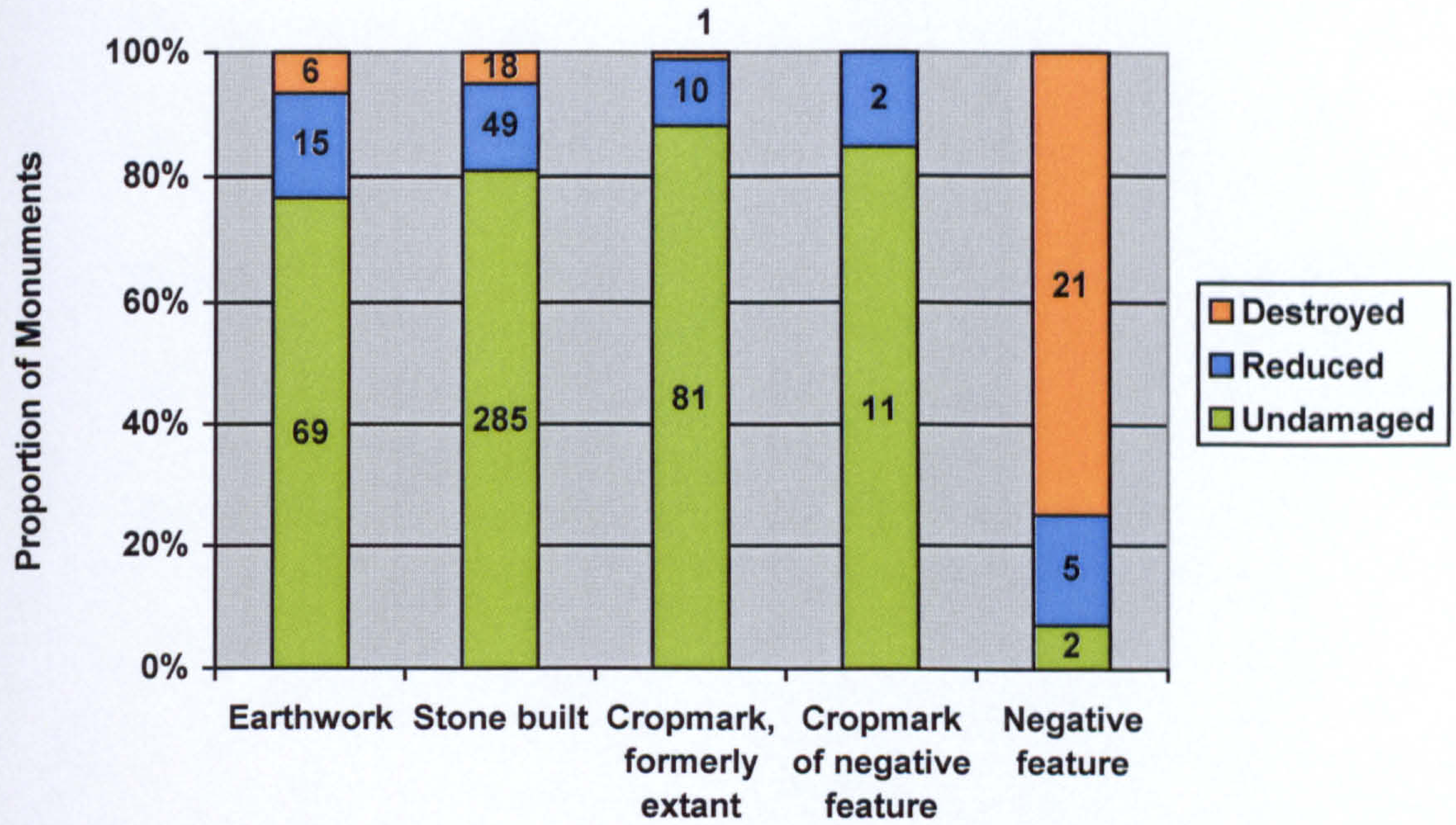

Figure 5.17. Uncalibrated numbers and proportions of monuments undamaged, reduced and destroyed according to construction type, where each monument is represented by one or more written description in the NMRS.

As figure 5.17 shows, by including only monuments with a written NMRS description in analysis, uncalibrated results suggest that earthworks have suffered greater loss since 1850 than stone built monuments, with about 17% reduced and 7% destroyed, compared with 14% reduced and 5% destroyed among stone monuments. This disparity in survival increases when analysis is based only on those monuments with two or more dated NMRS descriptions, as shown in figure 5.18.

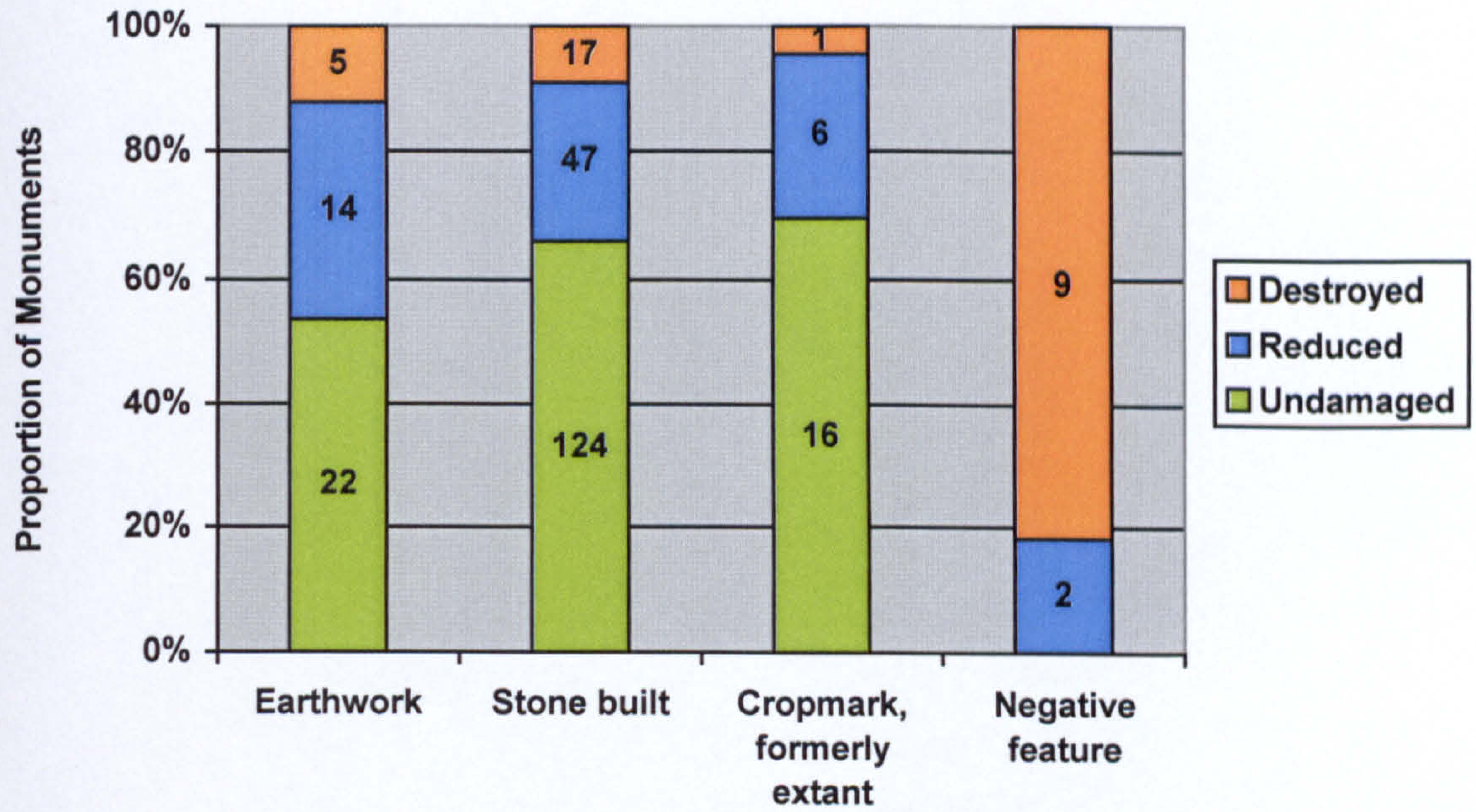

Figure 5.18. Uncalibrated numbers and proportions of monuments undamaged, reduced and destroyed according to construction type, where each monument is represented by two or more written descriptions in the NMRS

As figure 5.18 shows, using only these monuments (for which condition histories are easiest to construct on the basis of monument NMRS records), analysis suggests that only about 54% of earthwork monuments have remained undamaged since 1850, with some 34% reduced and 12% destroyed. Among stone built monuments, approximately 66% remain undamaged, with about 25% reduced and 9% destroyed.

5.5.2 Calibrated condition change and monument construction type

Using the results of the accuracy assessment to calibrate the results of the desk-based study, the figures produced for extant monuments undamaged, reduced and destroyed are not dissimilar to those shown in figure 5.18. As figure 5.19 (overleaf) shows, after calibration, the best-case scenario results for earthworks are 58% undamaged, 37% reduced and 5% destroyed. Among stone monuments, a maximum of 64% are undamaged, with at least 30% reduced and 6% destroyed.

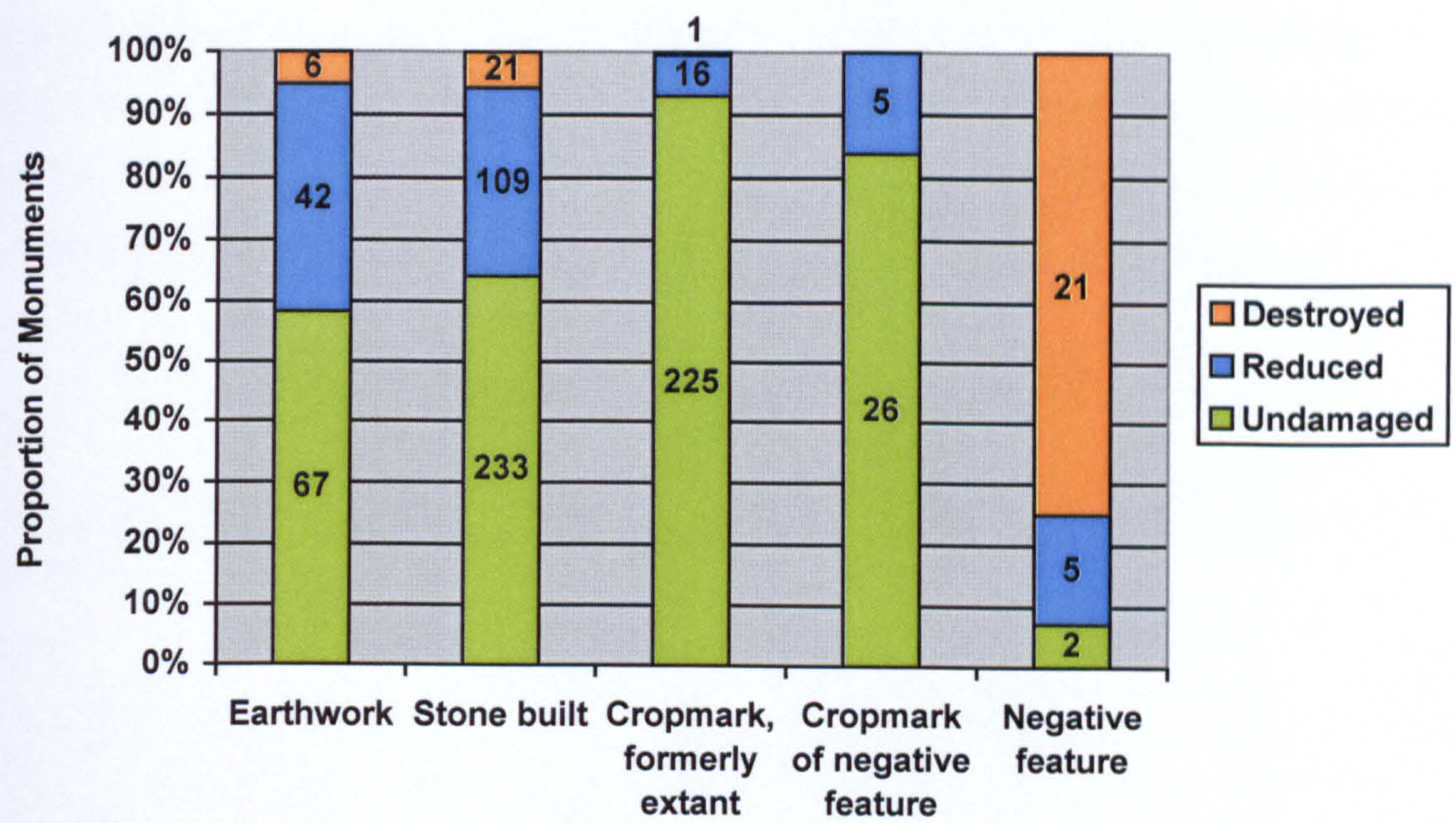

Figure 5.19. Calibrated numbers and proportions of sample monuments undamaged, reduced and destroyed according to construction type.

As noted in chapter 4, stone monuments such as tower-houses and stone circles generally have the longest history of recording within the sample, and consequently, these are the monuments for which condition histories are easiest to construct. It might be expected, therefore, that the desk-based study would record greater levels of loss among stone monuments. However, despite these biases in the recording of damage to stone built and earthwork monuments, both the calibrated and uncalibrated results of the desk-based study suggest that earthwork monuments within the sample have suffered greater loss since 1850 than stone built monuments.

5.5.3 Monument construction and damage types noted through desk-based study

The causes of damage and destruction to sample monuments recorded through the desk-based study are shown in table 5.8, which illustrates that 28 cases of damage or destruction have been recorded from the 109 earthwork monuments in the sample, equating to 0.26 cases per monument. Among stone built monuments, 81 cases have been recorded from 369 monuments, equating to 0.22 cases per monument.

	Earthwork		Stone built		Negative feature		Cropmark, formerly extant		Cropmark of negative feature		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	5	2	5	2	3	8					25
Development	3	1	2	2	3	5	2	1			19
Extraction					2	4					6
Forestry	2	1	7	2							12
Excavation	9		11		7	1	10		2		40
Building decay			3								3
Building renovation			3								3
Building re-utilisation			4								4
Demolition			2	1							3
Stone removal			1								1
Landscaping		1									1
Tree growth	1		1								2
Vandalism			1								1
Unknown	3		23	11	6	3	1				47
TOTAL	23	5	63	18	21	21	13	1	2	0	167

Table 5.8. Numbers of cases of monument damage (R) and destruction (D) identified through the desk-based study, according to monument construction type.

As table 5.8 shows, about 40% of noted damage to earthworks has occurred through archaeological excavation. The remaining cases of reduction noted have occurred through farming, forestry, development and tree growth, with three further cases of reduction through unknown causes, though two of these have probably been through farming operations. Farming, development, forestry and landscaping have accounted for all earthwork destruction noted.

Among stone built monuments, over a third of recorded loss (34 of 81 cases) has occurred through unknown causes, but of these 34 cases, five cases of destruction are likely to have been caused by the removal of buildings to increase land area available for arable production. Natural building decay probably accounts for eleven cases, and stone removal is the probable cause of seven reduction cases. Monument loss for which the cause is known is again dominated by archaeological excavation, but with farming, forestry and development again forming significant minorities. There are also damage types particular to standing buildings noted, such as renovation, re-utilisation and building decay.

5.5.4 Monument construction and damage types noted through the accuracy assessment

	Earthwork		Stone built		Negative feature		Cropmark, formerly extant		Cropmark of negative feature		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	2		12	1			1				16
Development	2		2				2		1		7
Extraction	1										1
Forestry	9		9								18
Excavation									1		1
Building decay			1								1
Building renovation			2		1						3
Building re-utilisation			1								1
Stone removal			1								1
Landscaping	1										1
Tree growth			1								1
Windthrow			3								3
Vandalism			1								1
Earth Tremor			1								1
Unknown			2								2
TOTAL	15	0	36	1	1	0	3	0	2	0	58

Table 5.9. Numbers of cases of monument damage (R) and destruction (D) identified through the accuracy assessment, according to monument construction type.

As shown in table 5.9, the types of damage noted through the accuracy assessment are similar to those noted through the desk-based study, though farming damage is confined almost exclusively to extant monuments. Damage recorded at earthworks through the accuracy assessment is dominated by forestry, with some farming and development related damage noted also. At stone monuments, a variety of damage causes have been identified through the accuracy assessment, but again, recorded damage is dominated by farming and forestry.

5.5.5 Summary of monument construction type and monument condition change

In assessing monument loss within the study area since 1850, the rate of loss of buried monuments and cropmarks is impossible to verify. Ploughing, development, mineral extraction and archaeological excavation dominate the causes of loss of negative features such as cists and souterrains. As noted in chapter 4, however, an unknown number of these monuments remain unrecorded and undamaged in the study area, while an equally unknown number have been damaged or destroyed without record. Consequently, the calibrated loss figures for buried features (7% undamaged, 18% reduced and 75% destroyed) are impossible to verify. Among cropmark monuments, damage levels recorded (92% undamaged, 7.5% reduced, 0.5% destroyed) are unrealistically low, and again dominated by development and archaeological excavation. As with non-cropmark buried features, it is inevitable that significant damage has occurred to cropmarks through agricultural operations, but as such damage is impossible to record without excavation, the desk-based study and accuracy assessment have been unable to identify this damage.

With extant monuments, rates of loss are easier to establish because damage or indications of to such monuments are usually visible. The calibrated results of the desk-based study show that a maximum of about 58% of earthwork monuments and about 64% of stone-built monuments remain undamaged since 1850. Although causes of recorded damage at both earth and stone monuments are dominated by farming operations, development, forestry and archaeological excavation, damage types exclusive to standing buildings have also played a significant role in recorded loss of stone-built monuments.

5.6 Monument condition change and land use

As chapter 4 and previous sections of this chapter have shown, much of the damage to sample monuments noted in the desk-based study and accuracy assessment is directly related to land use. Development, farming and forestry have caused at least 37% of loss noted through the desk-based study and about 72% of loss noted through the accuracy assessment. In chapter 3, meanwhile, it has been noted that numbers of sample monuments recorded vary with land use. Although numbers of monuments found within specific land cover categories are broadly indicative of the total areas of land cover type within the study area, in certain land cover types, fewer monuments are found than might be expected. For example, only about 5.5% of sample monuments are found within areas of forestry plantation, but forestry accounts for over 9% of land within the study area. Similarly, about 25 – 26% of monuments are found in areas of non-intensive land uses, but non-intensive land uses account for over 30% of the study area.

Perhaps the most significant pattern observed in chapter 3 is that approximately 11% of sample monuments are located either within small enclosures or within field margins or verges. Within areas with an LCS88 classification of arable / improved, about 32% (calibrated land use) of the 184 recorded extant monuments are situated in enclosures, verges and field margins. Although it is impossible to calculate, the proportion of land area taken up by field boundaries, verges and enclosures in this arable area must fall significantly short of 32%. It is likely that this high proportion of extant monuments found within enclosures and field margins in the arable zone can be attributed at least in part to the sheltered nature of their location, where they are less vulnerable to surrounding land uses.

While the census has suggested that variations exist in monument recording and long-term survival which may be at least partly attributable to land cover type, land use is seldom static. Within the study area, land cover has undergone significant change since the Second World War, as outlined in chapter 2. From the late 1940s to the late 1980s, the study area saw an overall increase in cultivated area, coupled with the removal of many field boundaries. This increase in cultivated area stopped in the late 1980s, and has been in slow decline since. Since the 1940s, there has also been a gradual increase in the overall area of commercial forestry, coupled with drainage of uplands for new planting. A third notable trend in land cover change has been a steady decline in the overall area of non-intensive land uses such as rough grazing and heather moorland. As noted in chapter 2, these changes in land utilisation in the latter part of the 20th century are likely to have had negative implications for archaeological monuments. The general expansion in the overall cropping area until the late 1980s may have been at the expense of previously uncultivated tracts of land, in which monuments might be expected to survive better. Furthermore, the removal of field boundaries may have resulted in the damage to or destruction of monuments, which had previously been afforded protection from the surrounding agricultural practices. Similarly, in the steady decrease in the overall area of non-intensive land uses such as rough grazing, primarily at the expense of commercial forestry, it is inevitable that monuments have been damaged and destroyed.

Through the desk-based study and accuracy assessment, it has been possible to assess the impacts of land use and land use change on the condition of sample monuments. The following section describes the relationships noted between current land use and monument condition relative to monument condition in 1850. This is followed by a short section examining the recorded impact of land use change on monument condition (section 5.7).

5.6.1 Uncalibrated monument condition change and land use

Figure 5.20 shows uncalibrated proportions of monuments undamaged, reduced and destroyed according to uncalibrated current land use at their locations.

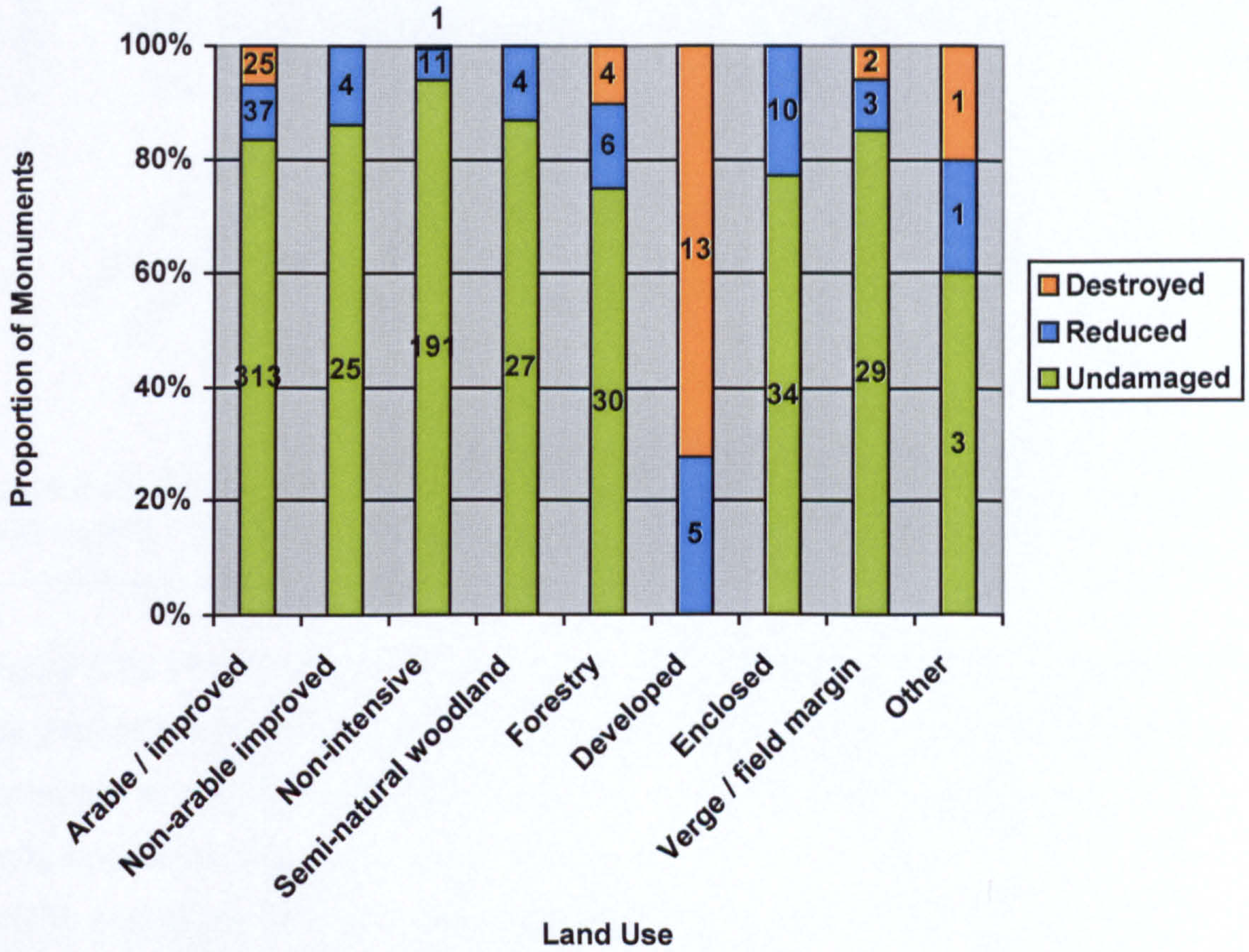

Figure 5.20. Uncalibrated numbers and proportions of sample monuments undamaged, reduced and destroyed according to uncalibrated land use.

Although figure 5.20 shows surprisingly low damage levels among monuments located in arable and improved land, it should be remembered that the majority of these monuments are cropmarks, at which damage is very difficult to detect. By examining only those sample monuments extant in 1850, a different situation can be observed.

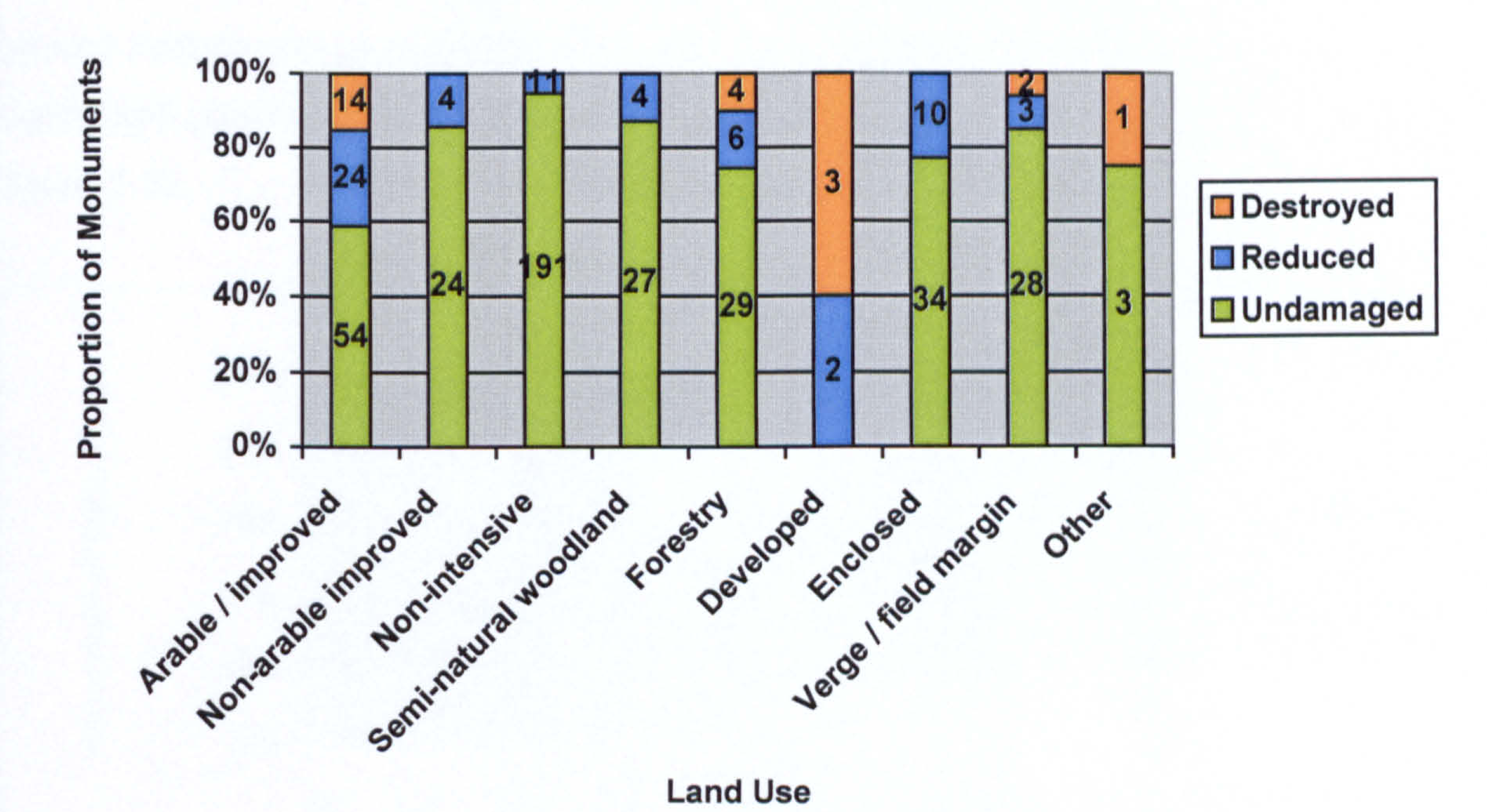

Figure 5.21. Uncalibrated numbers and proportions of extant sample monuments undamaged, reduced and destroyed according to uncalibrated land use.

As figure 5.21 shows, the uncalibrated results of the desk-based study suggest that fewer than 60% of extant monuments in arable and improved land have remained undamaged since 1850, with about 26% reduced and 15% destroyed. Monuments in forestry appear to have fared a little better, with about 74% undamaged, 15% reduced and 10% destroyed. While monument loss in arable / improved land and forestry is pronounced, uncalibrated levels of loss among monuments situated in areas of non-intensive land uses (such as unimproved grazing and moorland) are significantly lower, with about 95% recorded as undamaged since 1850. Recorded loss among extant monuments in non-arable improved land and semi-natural woodland is higher than among monuments in non-intensive land uses, while of the five extant monuments recorded in developed land, two are recorded as reduced with the remainder destroyed. That only about 77% of extant sample monuments situated in enclosures are recorded as undamaged is slightly surprising, but it should be remembered that many of these are standing buildings, which will deteriorate naturally if not maintained.

5.6.2 Calibrated monument condition change and land use

As shown in chapter 3, the land use recorded at sample monuments through the desk-based study has not always been accurate, particularly among monuments recorded through the desk-based study as being situated in field margins, semi-natural woodland and non-arable improved land. Because of these inaccuracies in recorded land use, it has been necessary to calibrate monument land use along with monument condition to ensure accuracy in assessing monument condition change in relation to land use. Calibrated condition and land use figures for all 779 sample monuments are shown in figure 5.22.

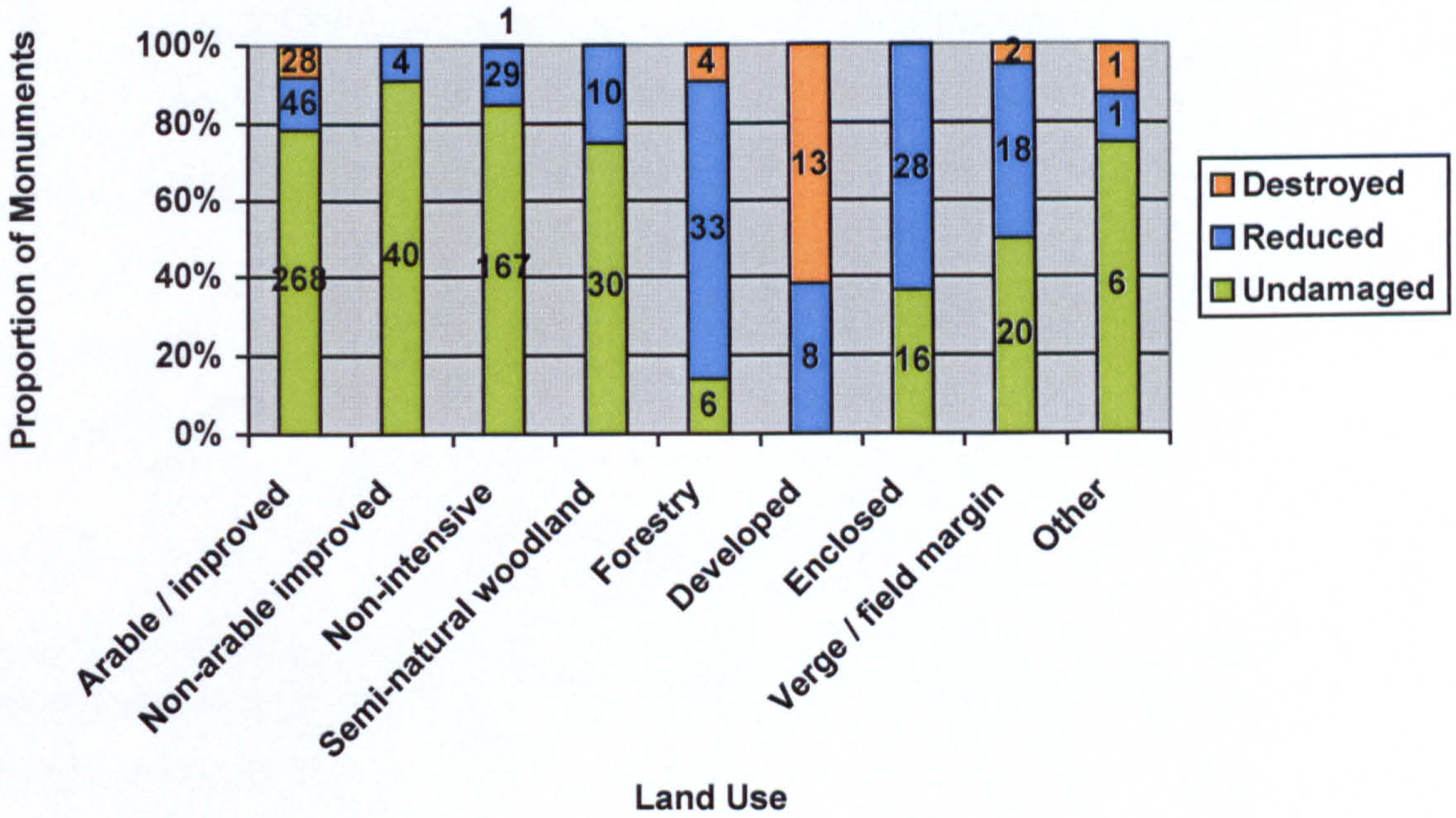

Figure 5.22. Calibrated numbers and proportions of sample monuments undamaged, reduced and destroyed according to calibrated land use.

As figure 5.22 shows, calibrated figures suggest higher levels of monument loss in most land uses than suggested by the desk-based study alone. Included in figure 5.22, however, are cropmark monuments and other buried features. As a result, levels of loss shown in figure 5.22 for monuments situated in arable and improved land are unrealistically low. Excluding all buried features and cropmarks from the calibrated totals enables the degree of loss to be assessed at extant monuments only, as shown in figure 5.23.

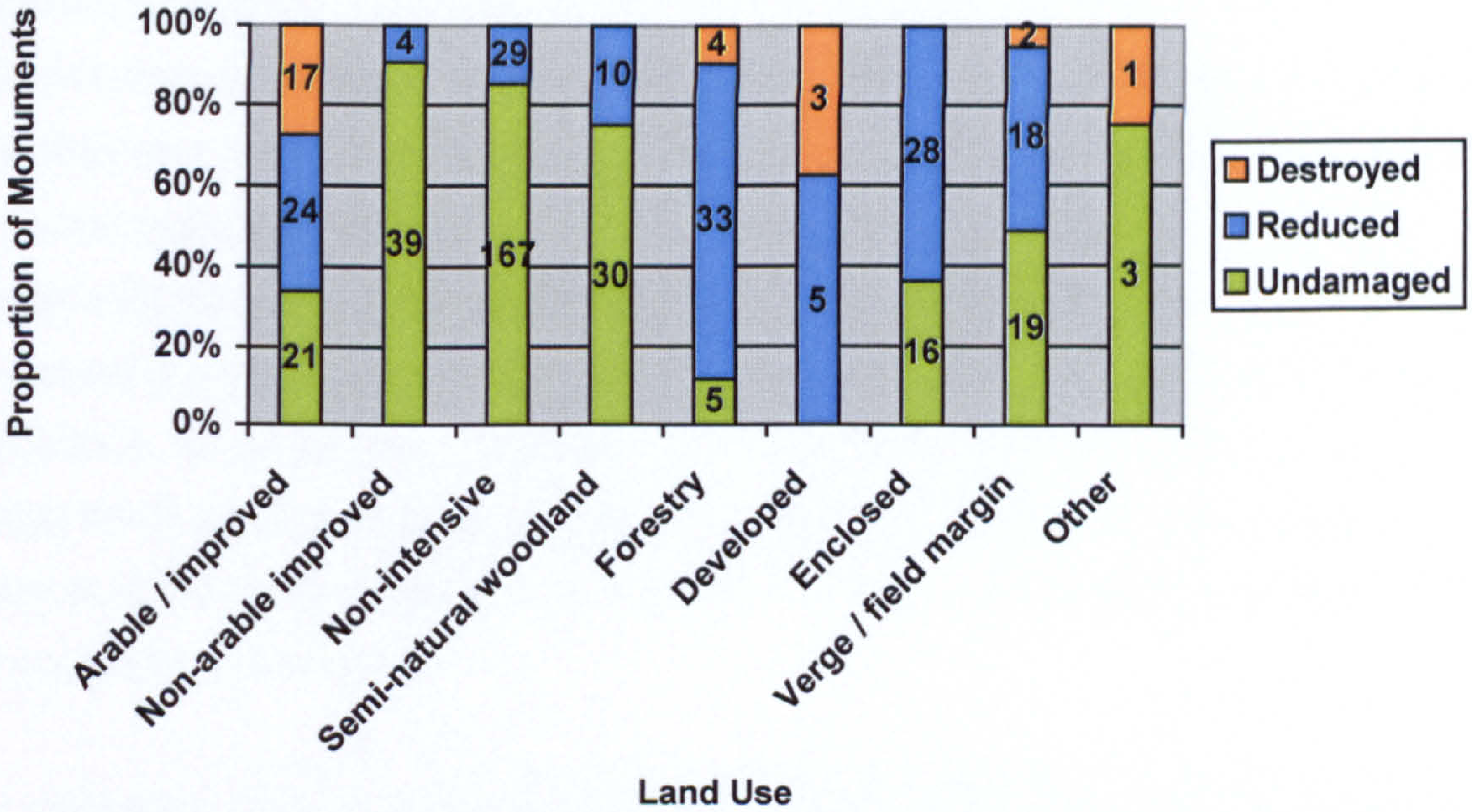

Figure 5.23. Calibrated numbers and proportions of extant sample monuments undamaged, reduced and destroyed according to calibrated land use.

Figure 5.23 shows that the increase in loss among extant monuments after calibration is most pronounced among monuments situated in arable / improved land, forestry, enclosed areas and verges or field margins. By contrast, calibrated loss figures remain comparatively low among monuments situated in non-intensive land uses and semi-natural woodland. Surprisingly, the lowest calibrated loss figures are found among monuments situated in non-arable improved land, where about 91% are recorded as undamaged, compared with about 85% undamaged in areas of non-intensive land uses. The reasons for this are difficult to ascertain, but they probably stem from the fact that the extant monuments examined through the accuracy assessment (and on which the calibration is based) vary in nature between non-intensive land uses and non-arable improved land. The group of 14 monuments examined during the accuracy assessment situated in non-arable improved land contains only two standing buildings, with the remainder being field monuments such as cairns and cultivation remains. By contrast, 15 of the 52 extant monuments recorded in non-intensive land uses during the accuracy assessment are standing buildings. Because these standing buildings are subject to natural processes of decay, which most field monuments are not, the high number of standing buildings recorded in non-intensive land uses though the accuracy assessment and low number recorded in non-arable improved land may have affected the calibrated results.

Among monuments situated in forestry, figure 5.23 shows that calibrated figures indicate an undamaged total of only about 12% (five of 42 monuments), with about 79% reduced and 9% destroyed. Among these reduced monuments, it is worth noting that some have been affected by planting within the 20 years, and that damage to these monuments is likely to increase as the trees mature. As figure 5.23 shows, after calibration, monuments found in enclosed areas again appear to have suffered considerable loss. It is important, however, to recognise that 24 of the 29 enclosed monuments examined as part of the accuracy assessment are standing buildings such as churches, tower-houses and dovecots, all of which will decay naturally if not maintained. It is perhaps little surprise, therefore, that the majority of enclosed monuments are recorded after calibration as reduced, but heartening to note that none are recorded as destroyed.

After calibration, the proportion of extant monuments situated in verges or field margins recorded as undamaged is about 49%, with some 46% reduced and 5% destroyed. Although the recorded level of damage to these monuments is high, seven of the 17 monuments examined during the accuracy assessment which are situated in field margins or verges are standing buildings, which will deteriorate naturally if not maintained. It is worth noting that over half of those monuments found in verges and filed margins are surrounded by arable land. Although nearly half are recorded as reduced since 1850, rates of loss (particularly destruction) among these monuments have been significantly lower than rates of loss among monuments situated in arable / improved land. This greater degree of survival is almost certainly due to the location of these monuments within areas of land where they are sheltered from the damaging effects of surrounding land uses.

As figure 5.23 shows, of the 62 extant sample monuments situated in arable / improved land, calibration suggests that a maximum of about 21 (34%) remain undamaged since 1850, with about 39% reduced and 27% destroyed. While this shows that monuments in arable / improved land have suffered significant loss, it is likely that the figure of 34% undamaged in arable land is an exaggeration. As outlined in chapter 2, arable land and improved pasture have been combined for the purposes of analysis, due to the difficulties involved in distinguishing between rotational pasture (as part of the arable cycle) and permanent pasture using a desk-based methodology. Because of this, improved pasture has only been referred to in analysis (as non-arable improved) where it is obvious that the land, although improved, has never been used for arable production. Where this distinction has not been possible, improved pasture has been included with arable land in analysis.

If the distinction *is* made between monuments recorded in arable land and those recorded in improved pasture (even accepting that some of this improved pasture is likely to be rotational and therefore part of the arable cycle), proportions of monuments recorded as undamaged, reduced and destroyed alter dramatically. Figure 5.24 shows uncalibrated totals of extant monuments in arable land and improved pasture (including those found in land classed as 'non-arable improved'), according to their condition as recorded through the desk-based study. The land cover distinction has been made using the LCS88.

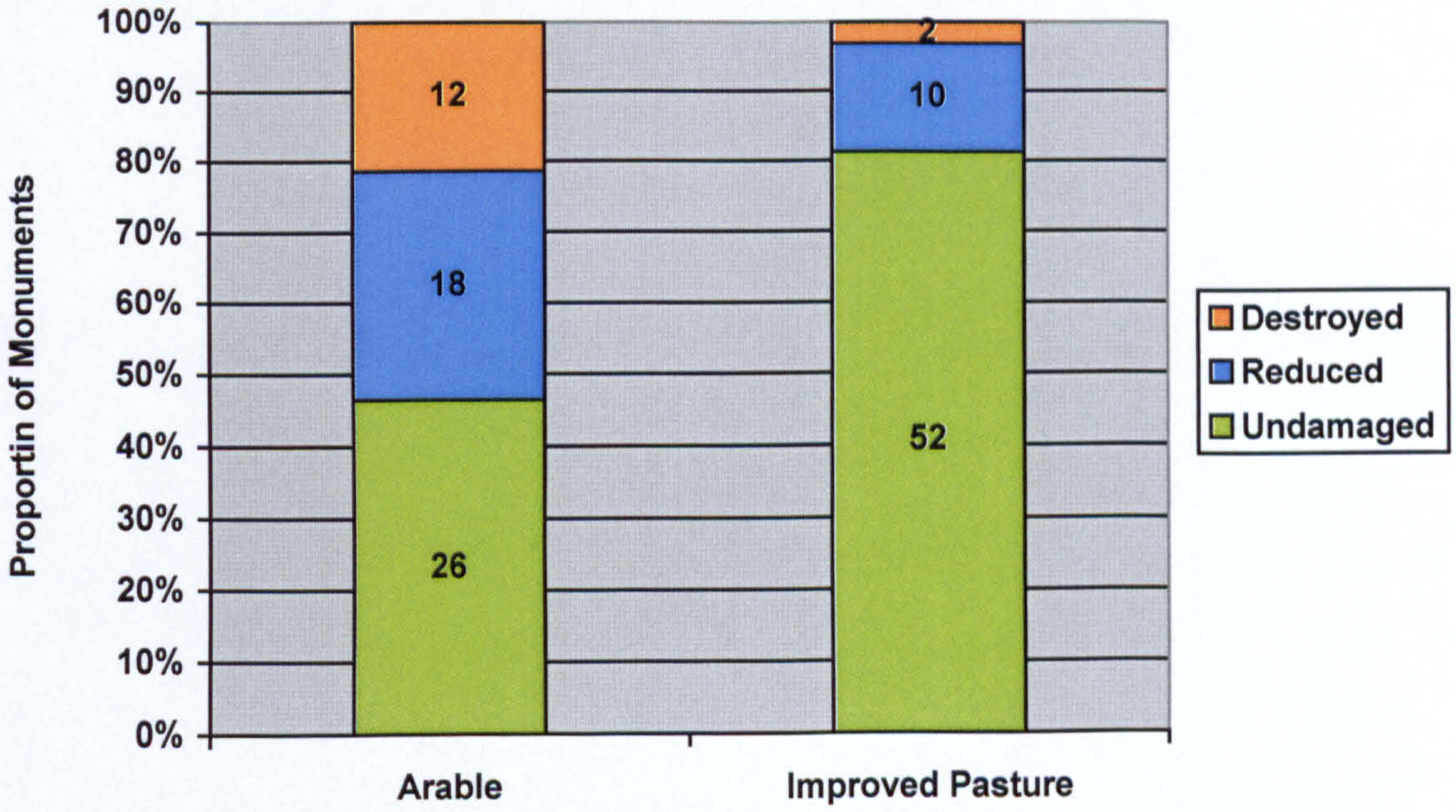

Figure 5.24. Uncalibrated numbers and proportions of extant monuments undamaged, reduced and destroyed in arable and improved pasture, according to uncalibrated land use.

As figure 5.24 shows, even before calibration, less than 50% of extant monuments in arable land are recorded as undamaged since 1850, with about 32% reduced and 21% destroyed. By contrast, over 80% of monuments in improved pasture are recorded as undamaged since 1850, with about 16% reduced and 3% destroyed. The degree of extant monument loss in arable land is emphasised when cropmarks are included in analysis with these extant monuments. The desk-based study records 314 cropmark or extant monuments in arable land. Of these, only 56 (about 18%) have been recorded as extant since 1850, with the remainder only ever having been recorded as cropmarks. Of these 56, only 26 (about 46%) are recorded through the desk-based study as undamaged since 1850. This shows that as a best-case scenario, only about 8% of sample monuments found in arable land are recorded as extant and undamaged since 1850.

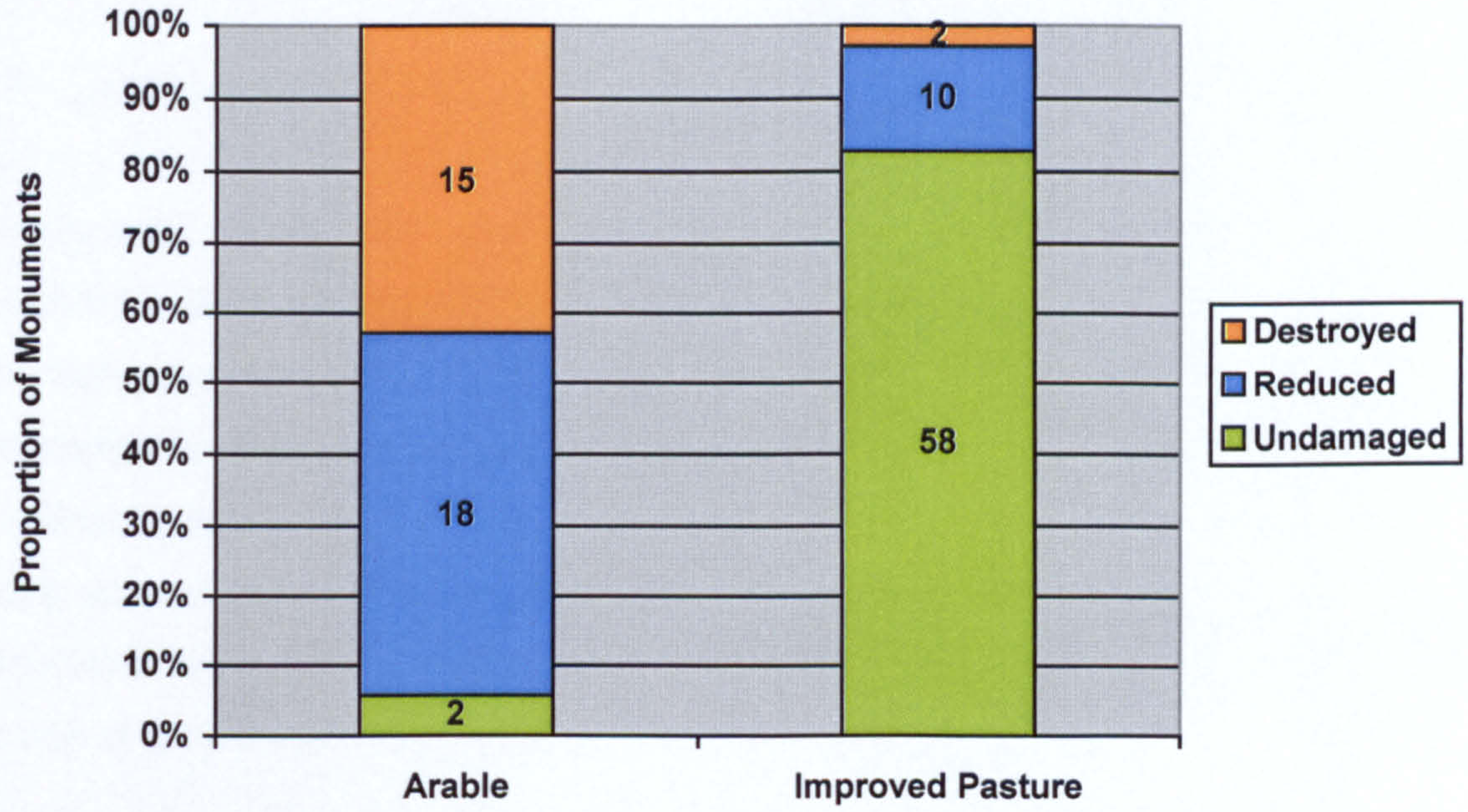

Figure 5.25. Calibrated numbers and proportions of extant monuments undamaged, reduced and destroyed in arable and improved pasture, according to calibrated land use.

After calibration, the differences in rates of loss between extant monuments in arable land and improved pasture are accentuated further. As figure 5.25, shows, calibrated results suggest that only about two (5%) of approximately 35 extant monuments in arable land are undamaged since 1850, with about 52% reduced and 43% destroyed. By contrast, about 83% of extant monuments in improved pasture are undamaged since 1850, with about 14% reduced and 3% destroyed. Again, the degree of loss of extant monuments arable land is emphasised when cropmarks are included in analysis with these extant monuments. Calibration of the monument land use figures produced by the desk-based study suggests that about 302 monuments from the sample of 779 are situated in arable land. Of these, only about 35 (about 12%) have been recorded as extant since 1850, with the remainder only ever having been recorded as cropmarks. After calibration, only about two of these 35 extant monuments (about 5%) are recorded as undamaged since 1850. This suggests that as a calibrated best-case scenario, less than 1% of sample monuments found in arable land are recorded as extant and undamaged since 1850.

While the calibrated figures presented above can be treated as indicative only, there can be little doubt that within the general land use category of 'arable / improved', the majority of loss has occurred at monuments situated in arable land rather than improved pasture.

5.6.3 Land use and the causes of monument condition change

As the previous section has shown, monument loss since 1850 has been greatest within arable land, developed land and forestry. Levels of loss have been pronounced also among monuments situated in enclosed areas and field margins. By contrast, monuments situated in less intensive land uses such as non-arable improved land (permanent pasture), semi-natural woodland and land uses such as unimproved grazing and moorland. It is important, however, to recognise the specific causes of loss within these land use areas, as not all recorded damage will be directly related to the land use in question.

	Arable / improved		Non-arable improved		Forestry		Semi-natural woodland		Non-intensive land uses		Developed land		Enclosed		Verge / field margin		Other		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	10	10	1	1							1	1	1						25
Development	3	1			1				1		4	8						1	19
Extraction		1								1	2	2							6
Forestry					5	3	3		1										12
Excavation	22	1			2				5		4		5				1		40
Building decay			1						1				1						3
Building renovation							1						2						3
Building re-utilisation			1						1				1		1				4
Demolition	1											1	1						3
Stone removal									1										1
Landscaping				1															1
Tree growth													1		1				2
Vandalism	1																		1
Unknown	16	11	2			1	2		3		4		4		2	2			47
TOTAL	53	24	5	2	8	4	6	0	13	1	15	12	16	0	4	2	1	1	167

Table 5.10. Counts of monument damage (R) and destruction (D) type identified through the desk-based study, according to uncalibrated main land use types.

Table 5.10 shows counts of recorded damage and destruction types according to uncalibrated land use, as recorded through the desk-based study. As the land use shown in table 5.10 is uncalibrated, not all of the figures shown will be accurate. They do, however, provide a rough indication of the types of damage, which will have dominated within certain land use types. As table 5.10 shows, although nearly half of all monument loss recorded through the desk-based study has occurred within arable / improved land, much of this loss is not attributable to farming operations. Archaeological excavation has accounted for 23 cases, while 27 cases of monument loss have occurred in arable / improved land for which no definite cause has been identified. Within this group of 27 cases attributable to unknown causes, it is likely that at least 13 have been caused by ploughing or removal of structures to increase the area of land available for arable production. Many of these cases have occurred at MoLRS sites included in the First Edition Survey Project, where the monuments have been shown unroofed within arable areas on the Ordnance Survey 1st Edition maps (about 1855-1860), but have been found upon recent visits to have been completely removed. As discussed in chapter 2, most FESP monuments were removed from the population of monuments from which the sample was extracted because their condition had never been verified through field survey. Among those FESP monuments which have been surveyed, however, it appears that in the lowlands at least, most of those omitted from later maps have been destroyed. This suggests that rates of MoLRS loss in lowland parts of the study area attributable to agricultural improvements have probably been significantly higher than the desk-based study and accuracy assessment have identified. As might be expected, loss attributable to forestry operations has dominated in areas of forestry and semi-natural woodland, while the majority of monument loss in developed land can be attributed to development and mineral extraction. Damage to monuments situated in enclosures has been dominated by archaeological excavation and damage types normally associated with standing buildings, such as demolition, re-utilisation and renovation.

While table 5.10 shows numbers of recorded cases of damage and destruction by land use according to the desk-based study, these figures should be treated as indicative only, as they are based on an uncalibrated record of land use. As chapter 3 has shown, the land use information for each of the sample monuments collected through the desk-based study has not always been accurate, particularly where monuments are situated in semi-natural woodland or small units of land such as enclosures and field margins. Through the accuracy assessment, it has been possible to make note of actual land use at some of the monuments where damage and destruction have been recorded through the desk-based study. As the accuracy assessment has examined only 258 sample monuments, however, it has not been possible to achieve this for all monuments where loss is recorded through the desk-based study.

Desk-based study (D) or accuracy assessment (A)	Arable / improved		Non-arable improved		Forestry		S-N woodland		Non-intensive		Developed		Enclosed		Verge / field margin		Other		TOTAL	
	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A
Farming	9	7	1	1									1	1	0	2			11	11
Development	2	2			1	1			1	1	1	1							5	5
Extraction																			0	0
Forestry					5	5	3	3	1	1									9	9
Excavation	14	13			2	1			3	4	2	2	5	6			1	1	27	27
Building decay			1	0			0	1	1	1									2	2
Building renovation							1	0					1	2					2	2
Building re-utilisation			1	0			0	1			0	1			1	0			2	2
Demolition	1	1											1	1					2	2
Stone removal									1	1									1	1
Landscaping																			0	0
Tree growth													1	1	1	1			2	2
Vandalism	1	1																	1	1
Unknown	12	10	2	0			2	2	3	4	1	1	4	4	2	5			26	26
TOTAL	39	34	5	1	8	7	6	7	10	12	4	5	13	15	4	8			90	90

Table 5.11. Numbers of monument loss cases at monuments checked during accuracy assessment, according to land use as recorded through the desk-based study (D) and accuracy assessment (A). Where figures are coloured red, this indicates that numbers of loss cases identified according to actual land use are higher than as identified through the desk-based study. Figures coloured blue indicate that numbers of loss cases identified according to actual land use are lower than as identified through the desk-based study.

Table 5.11 shows numbers of damage cases recorded at the 258 monuments used for the accuracy assessment, first according to land use as recorded by the desk-based study (D), and then by land use as recorded during the accuracy assessment (A). Where figures in table 5.11 are coloured red, this indicates that numbers of loss cases identified according to actual land use are higher than as identified through the desk-based study. Figures coloured blue indicate that numbers of loss cases identified according to actual land use are lower than as identified through the desk-based study. As table 5.11 shows, although numbers and types of damage cases recorded within some land use type remain largely unchanged, within others, damage recorded has increased or decreased. For example, within land use types which would normally cover a large geographic area, such as arable / improved and forestry, numbers of damage cases recorded have dropped after the correction of land use information. Conversely, damage recorded has increased in land uses which would normally be small in area, such as enclosed monuments and monuments found in field margins and verges.

	Arable / improved		Non-arable improved		Forestry		Semi-natural woodland		Non-intensive		Developed		Enclosed		Verge / field margin		
Reduced (R) or destroyed (D)	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	TOTAL
Farming	5	1	4						4				1		1		16
Development	5								1						1		7
Extraction	1																1
Forestry	1				11		2		2						2		18
Excavation	1																1
Building decay															1		1
Building renovation													2		1		3
Building re-utilisation											1						1
Stone removal									1								1
Landscaping	1																1
Tree growth					1												1
Windthrow					1		1						1				3
Vandalism							1										1
Earth Tremor													1				1
Unknown	2																2
TOTAL	16	1	4	0	13	0	4	0	8	0	1	0	5	0	6	0	58

Table 5.12. Counts of monument loss type identified through the accuracy assessment, according to calibrated main land use types.

The 58 cases of damage or destruction noted through the accuracy assessment not previously noted through the desk-based study are shown in table 5.12. As with the damage types noted through desk-based study, most farming-related damage has occurred in arable and improved land, although farming-related damage is also found in areas of non-intensive land use, such as vehicle and stock damage in rough grazing. Similarly, forestry damage is concentrated in areas of forestry, although forestry-related damage has also been recorded at monuments found in semi-natural woodland and non-intensive land uses. This is because the land use type used in table 5.12 is the predominant land use type, but as described in section chapter 3, many of the sample monuments are situated within two or even three different land cover types. For example, the forestry damage cases shown in table 5.12 which at monuments situated in non-intensive land use areas have both occurred where the main land cover type is rough grazing, but where forestry has clipped the edge of the monument. Similarly, all five cases of development damage recorded in arable / improved land have occurred where road building, pipeline construction or housing development have impinged on the edge of a monument.

5.6.4 Summary of monument condition change and land use

The results of the desk-based study and accuracy assessment show that levels of damage noted at sample monuments vary significantly according to land use, although not all damage is necessarily directly attributable to land use. Among monuments located in intensive land use types such as arable, forestry and developed land, levels of monument loss have been high, while non-intensive land uses such as permanent pasture and unimproved grazing appear to have had less impact on monument condition. As noted at the start of this section, the census (chapter 3) has recorded about 10% of sample monuments as being located within small enclosures, verges and field margins, and that many of these monuments are surrounded by more intensive land uses such as arable. This section has shown that although calibrated levels of loss among monuments situated in enclosures, verges and field margins are higher than might have been expected, rates of loss among these monuments have been markedly lower than among those monuments situated in the more intensively utilised surrounding areas.

5.7 Monument loss and land use change

As the previous section of this chapter has shown, much of the monument loss identified within the study area can be attributed to changes in land use. For example, several of the sample monuments situated at high altitudes have suffered reduction or complete destruction through a change in land use to forestry, while urban expansion has led to the loss of several monuments in lowland areas. As set out in section 2.3, one of the objectives of this research has been to assess the impacts of changes in land use within the study area since 1850 on the condition of archaeological monuments. Within the last 60 years in particular, significant changes have taken place in land utilisation, resulting in a continuous decline in the area of non-intensive land uses and a continuous increase in the area of forestry. The area of urban land has expanded steadily, while trends in the expansion and contraction of arable land area have been more fluid, largely determined by economic factors, as described in section 2.2.5.

Originally, the intention of this research was to examine land use change at each of the sample monuments since 1850 to see how this would compare with changes in monument condition. This could, however, have led to misleading results, as monuments which have experienced a change in land use may have been damaged or destroyed through events unrelated to land use change. In order to eliminate such misleading analysis, it has been possible instead to examine each of the cases of damage and destruction identified through the desk-based study and accuracy assessment and determined which have been as a result of land use change.

Monument Type	To arable / improved	To developed	To forestry	To semi-natural woodland	To water	To non-intensive	Total
Earthwork	3	3	3	1	1		11
Stone built		2	6	1		2	11
Cropmark		3					3
Negative feature		9					9
Total	3	17	9	2	1	2	34

Table 5.13. Numbers of cases of monument loss attributable to land use change recorded through desk-based study.

Table 5.13 shows numbers of cases of monument loss identified through the desk-based study as having been caused by land use change, and demonstrates that of the

167 cases identified, 34 are attributable to land use change. Eleven of these have occurred at earthwork monuments, compared with 17 cases of loss at earthworks which have not been related to land use change. By contrast, eleven loss cases attributable to land use change have occurred at stone-built monuments, compared with 70 cases of loss at stone-built monuments which have not been related to land use change. This suggests that land use change is likely to have had a more significant impact on earthworks than on stone-built monuments, as about 39% of loss at earthworks has occurred through land use change, compared with only about 14% at stone-built monuments. Among buried features, nine cases of loss have been attributable to land use change (about 21% of cases at buried features), while at cropmark monuments, land use change has accounted for three cases of loss, equating to about 16% of loss cases recorded at cropmarks. As table 5.13 shows, the most common land use changes responsible for loss recorded through the desk-based study are to arable (3 cases), to developed (17 cases), and to forestry (9 cases).

While only about 20% of monument loss identified through the desk-based study can be attributed to land use change, the results of the accuracy assessment suggest that land use change has had a greater impact on monument condition than the desk-based study has been able to identify.

Monument Type	To arable / improved	To developed	To forestry	To enclosed	Total
Earthwork	1	1	3	2	7
Stone built		1	8		9
Cropmark		2			2
Total	1	4	11	2	18

Table 5.14, Numbers of cases of monument loss attributable to land use change recorded through accuracy assessment.

As table 5.14 shows, 18 of the 58 cases (about 31%) of monument loss identified through the accuracy assessment are attributable to land use change. This rate is highest at earthwork monuments, where fifteen cases of loss have been identified, seven of which (about 47%) are attributable to land use change. Among stone monuments, the rate of identified loss attributable to land use change is lower, with nine of 37 cases (about 24%) attributable to land use change. As table 5.14 shows, the most significant land use change in causing monument loss has been a change to forestry, usually from a non-intensive land use such as moorland. Development has also played a role, accounting for four cases of monument loss. The two cases of loss shown in table 5.14 attributable to a change to enclosed land use have occurred at the same monument, and merit some discussion. In the year 2000, under the Countryside Premium Scheme, the landowner enclosed an area from which stock were to be excluded after early spring. This was undertaken in order to encourage wildflower growth within the enclosed area, which took in a water course. The enclosed area contains a group of about eight turf-walled structures, and so stock removal from this area should have proved beneficial to the archaeological remains. Unfortunately, immediately after the fencing works (which damaged two of the structures), the landowner placed stock in the enclosed area to utilise the grazing there before the date at which stock exclusion was to begin. As the stock were concentrated into a small area, within which feed bins were sited inappropriately and vehicles were used, significant damage occurred (figure 5.26), with two structures in particular damaged to such an extent that they could not be located during survey. Discussions with the landowner showed that he was unaware of the extent of the archaeological remains.

Figure 5.26. Cattle poaching at one of the group of turf-walled structures damaged by works undertaken through the Countryside Premium Scheme. Monument name and location withheld.

The one case of monument loss attributable to land use change to arable shown in table 5.14 is also worthy of discussion. The monument in question is a tower and associated earthworks known as Ha' Tower, situated close to the village of Dunning in Perthshire (NMRS number NO01SW 8). Shown in vertical aerial photographs taken in 1948 to be situated within semi-natural woodland, the trees were removed by 1965, leaving the tower and earthworks clearly visible in vertical aerial photographs (figure 5.27). By 1988, however, the land had been converted to arable, by which time aerial photographs show that the tower had been removed and the earthworks visible only as cropmarks. Today, the monument is visible as cleared stone at the field margin and a few amorphous undulations in pasture, where the earthworks have been levelled (figure 5.28). Although the desk-based study and accuracy assessment have identified a number of monuments at which gradual ploughing encroachment has caused damage or monuments have been removed altogether to increase the area of land available for cropping, the Ha' Tower is the only recent case identified through this research where a monument has been lost through a wholesale change in land use to arable.

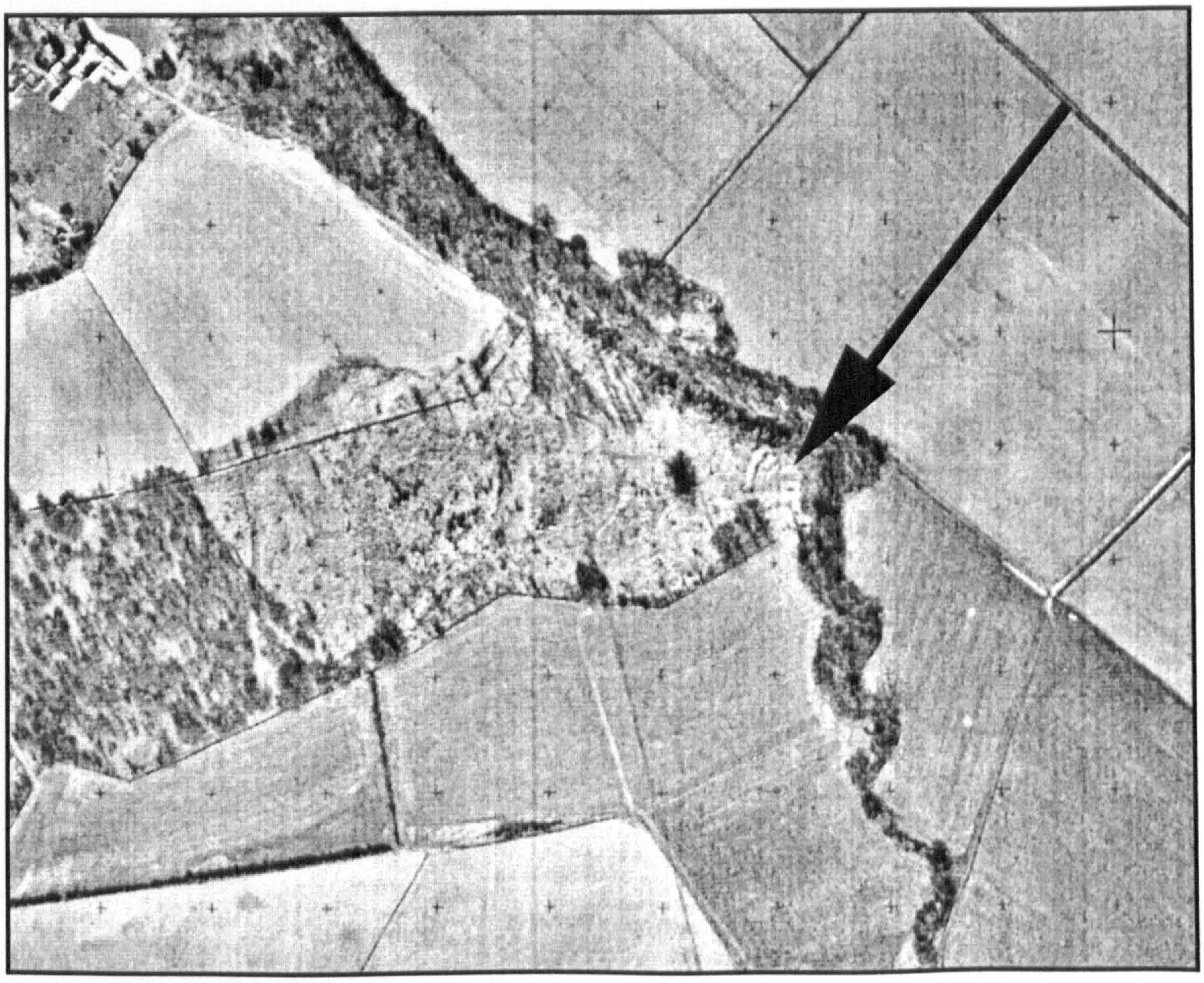

Figure 5.27. Vertical aerial photograph (1965) showing earthworks visible at Ha' Tower, Dunning. © *Crown Copyright RCAHMS.*

Figure 5.28. The location of the tower and earthworks at Ha' Tower as it look today.

Although the results of the desk-based study have suggested that little of the observed monument loss can be attributed to land use change, the accuracy assessment (which has used more reliable data sources) suggests that land use change has been a significant cause of monument loss, particularly among earthworks. The various trends in land use change identified in chapter 2 are reflected in the sample of monuments, with urbanisation and forestry expansion accounting for about 19% of the monument loss recorded through the desk-based study and accuracy assessment. The impact of agricultural expansion has been less obvious than had been expected, however, causing only four recorded cases of monument damage or destruction.

5.8 Monument condition change and scheduling

As discussed in chapter 3, some 22% of sample monuments are scheduled ancient monuments, and as such, are afforded statutory protection by the Scottish Ministers. Although the earliest scheduling among the sample monuments dates to the 1920s, the majority of scheduling within the study area has taken place in the last 15 years, when cropmarks have been scheduled in increasing numbers. It might be expected that given their legal protection, scheduled monuments within the sample will have suffered less damage than unscheduled monuments. The results of MARS suggest this to be the case in England, with 7.5% of scheduled monuments in the MARS sample destroyed, compared with a destruction rate of 16% within the overall recorded archaeological resource (Darvill and Fulton 1998, 201). Assessing the effectiveness of scheduling as a means of preserving monuments is not without complications, however. Although scheduling should have a bearing on the condition and preservation of a monument, the condition of a monument also has a bearing on whether or not it will be scheduled. Eight unranked criteria are used to assess monuments for scheduling. Among these criteria is the consideration of a monument's survival and condition (Breeze 1993, 45). Consequently, many monuments (such as badly mutilated and excavated burial cairns) will not be scheduled due to their poor state of preservation, whereas a well-preserved burial cairn probably will. In assessing the effectiveness of scheduling as a means of preserving archaeological remains, therefore, it is important to recognise this bias.

5.8.1 Uncalibrated monument condition change and scheduling

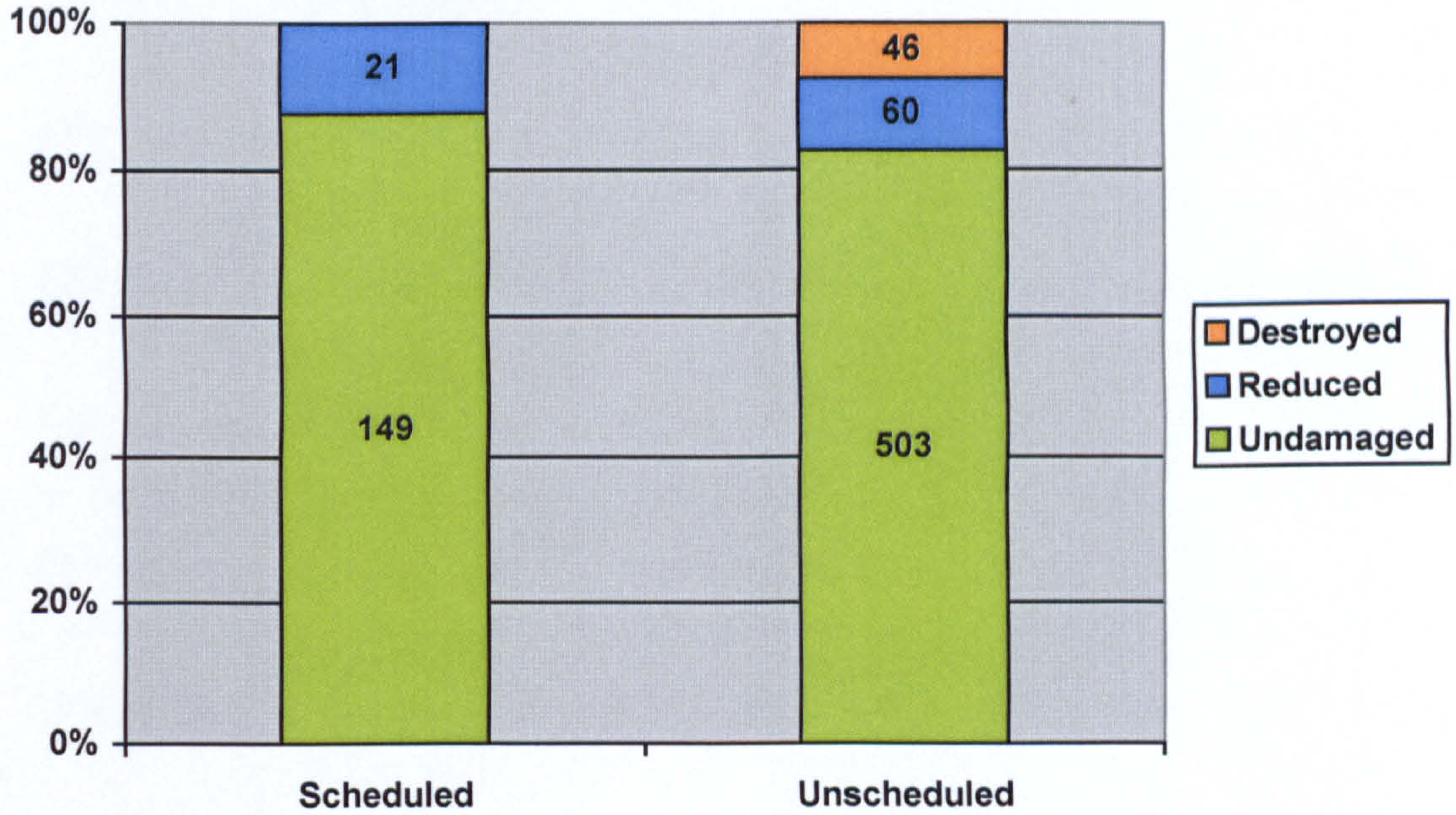

Figure 5.29. Uncalibrated numbers and proportions of monuments undamaged, reduced and destroyed according to scheduled or unscheduled status.

Figure 5.29 shows that only about 12% of scheduled monuments are recorded as damaged by the desk-based study, compared with 10% damaged and 8% destroyed among unscheduled monuments. Given the high number of cropmark monuments in the sample and the difficulties in identifying damage to these monuments, however, these statistics are impossible to verify. By examining only extant sample monuments, however, a different pattern can be observed.

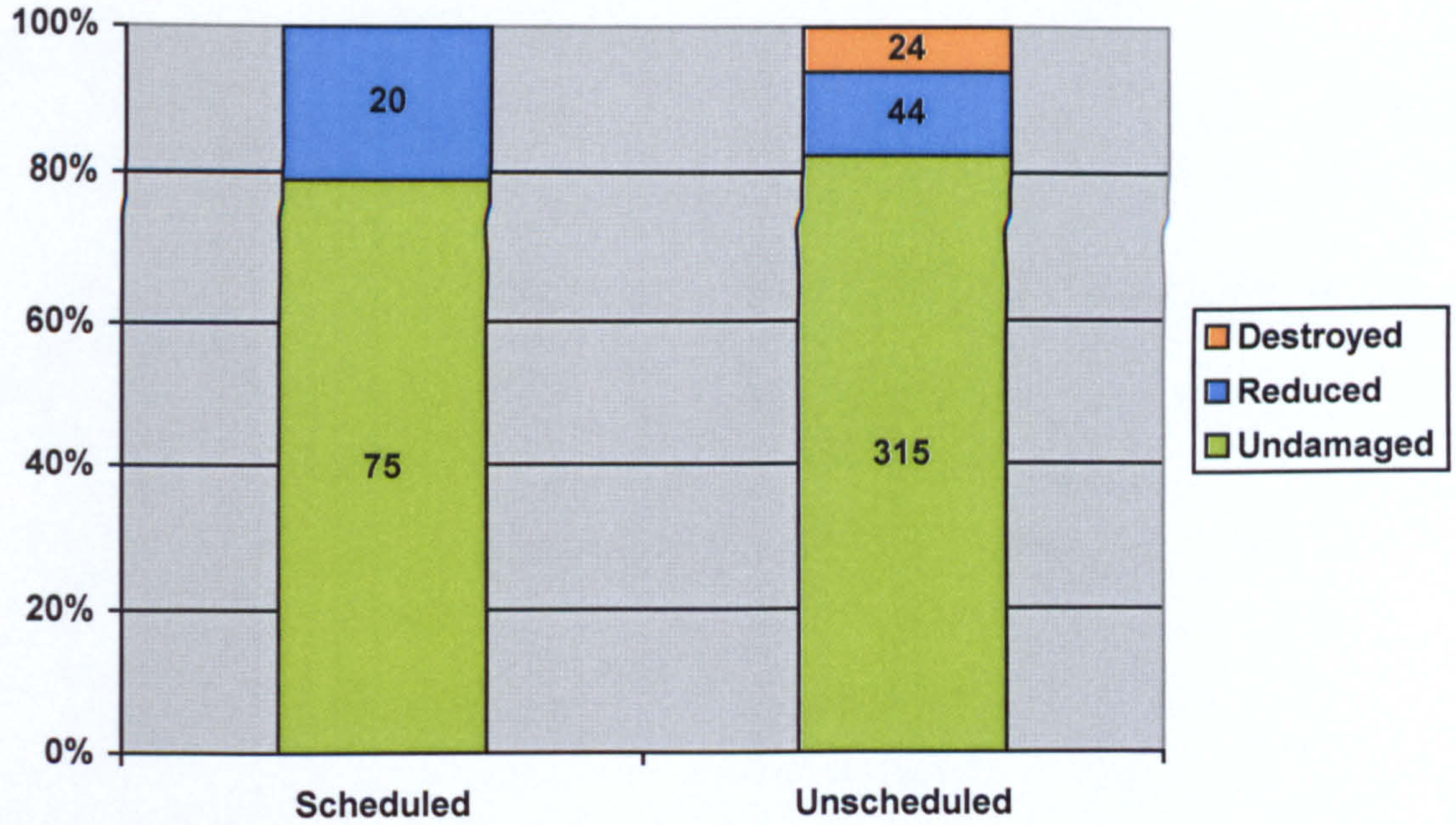

Figure 5.30. Uncalibrated numbers of extant monuments undamaged, reduced and destroyed according to scheduled or unscheduled status.

As figure 5.30 shows, among scheduled extant sample monuments, about 21% are recorded as reduced through the desk-based study, compared with about 12% reduced and 6% destroyed among unscheduled monuments. While this might suggest that scheduling is not an effective means by which to protect monuments, examination of the types of damage recorded through the desk-based study helps explain the unexpectedly high level of damage among scheduled monuments. Table 5.15 (overleaf) shows types of damage recorded through the desk-based study at scheduled and unscheduled sample monuments, and demonstrates that of the 30 cases of damage to scheduled monuments recorded through the desk-based study, half have been attributable to archaeological excavation. This is little surprise, considering that many of these are monuments that have held academic and archaeological interest for a long time. No damage attributable to development or mineral extraction has been recorded at scheduled monuments through the desk-based study, while a fifth of the damage recorded is through unknown causes. Forestry and farming have played a role in the recorded damage at scheduled sample monuments, but none of these cases have occurred since the monuments in question have been scheduled. Indeed, it is worth noting that that of the 30 cases of damage recorded at scheduled monuments through the desk-based study, only 11 have occurred since the monument was scheduled. Of these, nine have occurred through archaeological excavation, with a single case of renovation (at Elcho Castle, a Property in Care) and a single case attributable to unknown causes.

	Scheduled Monuments		Unscheduled Monuments		
Reduced (R) or destroyed (D)	R	D	R	D	TOTAL
Farming	2		11	12	25
Development			10	9	19
Extraction			2	4	6
Forestry	3		6	3	12
Excavation	15		24	1	40
Building decay	1		2		3
Building renovation	1		2		3
Building re-utilisation	1		3		4
Demolition			2	1	3
Stone removal	1				1
Landscaping				1	1
Tree growth			2		2
Vandalism			1		1
Unknown	6		27	14	47
TOTAL	30	0	92	45	167

Table 5.15. Cases of damage (R) and destruction (D) recorded through the desk-based study at scheduled and unscheduled sample monuments

As table 5.15 shows, the predominant causes of monument loss are different among unscheduled monuments. Although archaeological excavation is again the single largest recorded cause of monument loss, the desk-based study shows that farming, forestry, development and mineral extraction have played a significant role in monument loss (particularly monument destruction), while unknown causes have accounted for nearly a third of recorded loss among unscheduled monuments.

5.8.2 <u>Calibrated monument condition change and scheduling</u>

After calibration, numbers of monuments recorded as damaged and destroyed alter considerably.

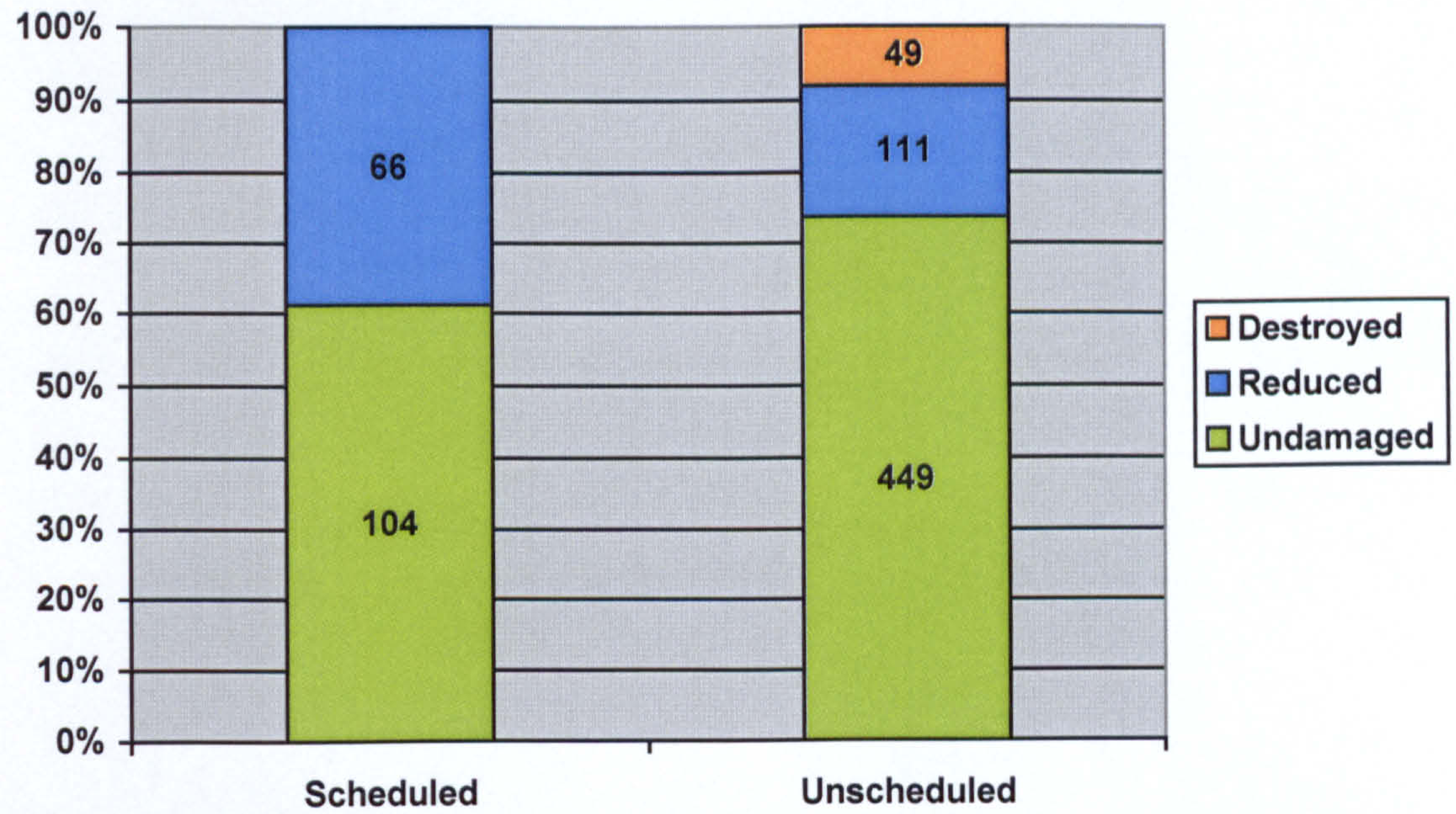

Figure 5.31. Calibrated numbers and proportions of monuments undamaged, reduced and destroyed according to scheduled or unscheduled status.

As figure 5.31 shows, after calibration, only 60% of scheduled monuments are recorded as undamaged, compared with about 73% of unscheduled monuments. Among extant monuments, this disparity is even more pronounced, with only about 35% of scheduled monuments recorded as undamaged, compared with about 70% of unscheduled monuments, as shown in figure 5.32 (overleaf). The surprisingly high level of damage among scheduled monuments is attributable to the data types used to assess condition change at these monuments during the accuracy assessment. Of the 67 scheduled monuments included in the accuracy assessment, only one has been assessed using aerial photographs only. The remainder have been assessed using field survey (eight monuments) and Monument Warden condition reports (58 monuments). By contrast, of the 191 unscheduled monuments included in the accuracy assessment, 68 have been assessed using vertical aerial photographs, 70 using oblique aerial photographs, and 53 through field survey. As noted in chapter 4, field survey and the use of Monument Warden reports have proved very effective as means of recording monument loss not noted by the desk-based study, while the use of aerial photographs has been less successful. It is little surprise, therefore, that the calibrated results of the desk-based study show a high degree of damage among scheduled monuments, given the data sources on which the calibration for scheduled monuments has been based.

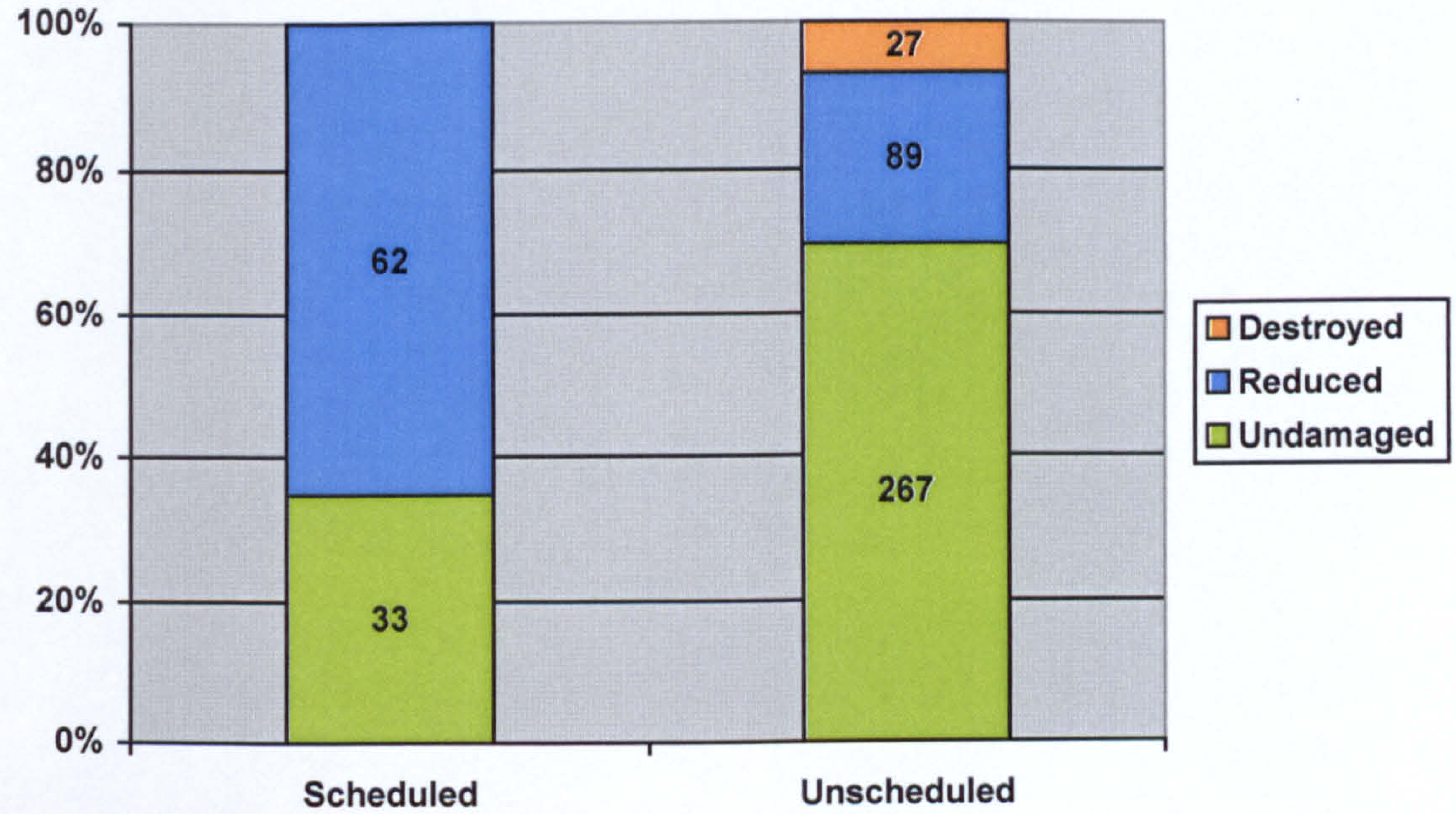

Fig 5.32. Calibrated numbers and proportions of extant sample monuments undamaged, reduced and destroyed according to scheduled or unscheduled status.

In providing a comparison between rates of loss at scheduled and unscheduled monuments, it is clear that these calibrated figures are unreliable, given the biases in the datasets used to calibrate the desk-based study results. These figures, however, do illustrate again that field survey (and, in this case, systematic condition survey) will identify significant levels of monument loss not detectable through a desk-based study.

The causes of monument loss identified at scheduled and unscheduled monuments through the accuracy assessment are shown in table 5.16.

	Scheduled Monuments		Unscheduled Monuments		
Reduced (R) or destroyed (D)	R	D	R	D	TOTAL
Farming	5		10	1	16
Development	3		4		7
Extraction			1		1
Forestry	9		9		18
Excavation	1				1
Building decay			1		1
Building renovation	2		1		3
Building re-utilisation			1		1
Stone removal			1		1
Landscaping	1				1
Tree growth	1				1
Windthrow	2		1		3
Vandalism	1				1
Earth Tremor	1				1
Unknown			2		2
TOTAL	26	0	31		58

Table 5.16. Causes of damage recorded through the accuracy assessment at scheduled and unscheduled sample monuments

Again, any differences in the levels of monument loss noted through the accuracy assessment between scheduled and unscheduled monuments cannot be treated as accurate, given the biases in the datasets used during the accuracy assessment. Table 5.16 does, however, show that the types of damage found at scheduled monuments are largely the same as those found at unscheduled monuments, with farming, forestry and development related damage dominating at both groups of monuments.

5.8.3 Summary of monument condition change and scheduling

In summary, it can be seen that the methodology used does not enable an assessment of the effectiveness of scheduling as a means of monument preservation, for a variety of reasons. Firstly, the condition of a monument has a bearing on whether or not it will be scheduled, meaning that monument condition can determine presence or absence of scheduling rather than scheduling determining monument condition. Secondly, and more importantly, the use of Historic Scotland Monument Warden reports to determine condition change among scheduled monuments during the accuracy assessment has created significant biases in the calibrated results of the desk-based study. It is, however, fair to say that of the monuments surveyed as part of the accuracy assessment, scheduled monuments were found to be consistently in better general condition than unscheduled monuments. One of the main reasons for this is likely to be that during the programme of field survey, landowners with scheduled monuments appeared to be far more aware of the archaeology on their land, whereas many of the landowners with unscheduled monuments were unaware of their existence. This trend, unfortunately, is not quantifiable through the present research, although its existence has been borne out at least in part through discussions with landowners during the programme of field survey. This apparent link between a monument's condition and awareness of its presence among those managing the surrounding land suggests that scheduling may provide an essential component of securing the preservation of a monument, namely that it makes landowners aware that they have important archaeological remains on their land.

5.9 Monument condition change in its environmental context: summary

In this chapter, the research has sought to quantify and analyse monument condition change since 1850 and identify the processes responsible for this loss with reference to the physical landscape within which the monuments are set. Specifically, this chapter has examined relationships between monument condition change and environmental variables such as altitude, Land Capability for Agriculture (LCA), land use and land use change. Monument condition change has also been examined in relation to local authority area, period and material construction. Finally, an assessment of the effect of scheduling on observed condition change among of sample monuments has been undertaken. As this chapter has shown, there are clear relationships between monument condition change and a number of these variables, many of which are dependant on each other. For example, land use is determined by environmental factors such as elevation and LCA, and so it is little surprise that those monuments situated at high altitudes are also those monuments situated in areas of low agricultural potential, and, consequently, low intensity land uses. As might be expected, many of the analyses have produced similar results between related environmental variables such as land use, elevation and LCA, though some of the trends identified appear to be attributable to individual monument characteristics such as period of construction and the materials with which the monuments have been built. Detailed conclusions are presented in chapter 7, but as a general rule, it appears to be those monuments situated 'closest to the road' which have undergone the greatest levels of damage and destruction, while those located in more remote areas have survived the last 150 years relatively unscathed. Exceptions to this rule have occurred, most notably among monuments in upland areas which have been affected by forestry within the last 50 years, but it unquestionable that recorded monument loss has been highest in the more intensively utilised parts of the study area. It is, however, within these intensively utilised areas that a large number of sample monuments are found for which condition change is virtually impossible to record. As this chapter and the previous chapter have shown, changes in the condition of cropmark monuments cannot be assessed accurately using a desk-based methodology, even if field survey is used as a validation tool. Of all sample monuments, however, it is these that are subject to the greatest pressures of land use, and so alternative methods have been sought by which their condition can be assessed. These methods, and the results they have produced, are described in chapter 6.