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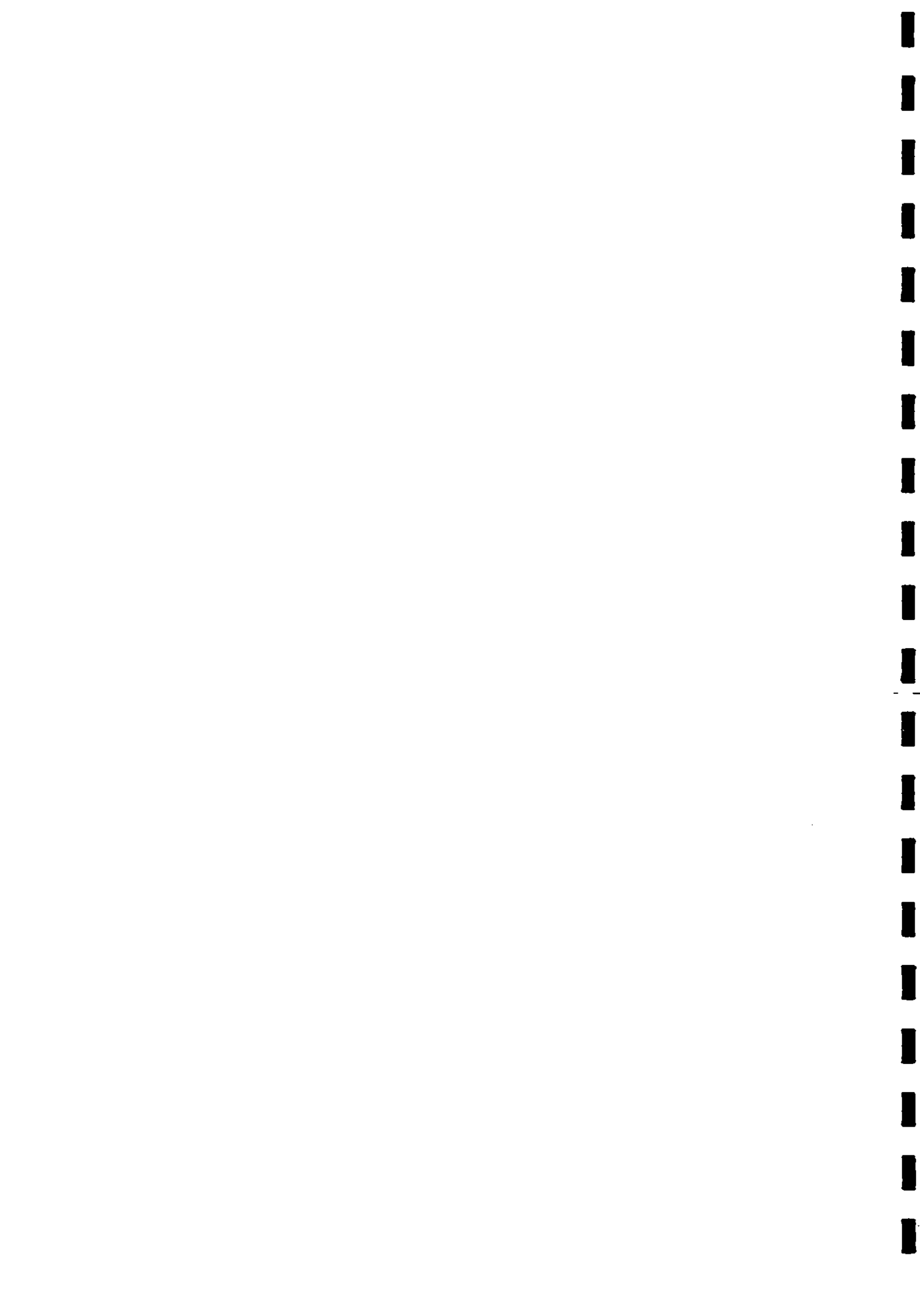
Report to Department of Environment

Bracken distribution and management:
PROGRESS REPORT

R H MARRS & R J PAKEMAN

Institute of Terrestrial Ecology
Monks Wood Experimental Station
Abbots Ripton
Huntingdon
Cambs PE17 2LS

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INTRODUCTION

Bracken is a major weed problem in Britain particularly in upland areas. It causes problems for agriculture, forestry, conservation, livestock health and possibly human health. Control methods have generally either proved unsatisfactory, or have given inconsistent results in the long-term. From a policy point of view there is a need to establish:

- (1) The ecological pros and cons of the bracken habitat. Are there any desirable features associated with bracken? What are the drawbacks of allowing it to continue to cover large areas of upland Britain?
- (2) Why bracken control is either difficult or inconsistent?
- (3) A reliable assessment of how much bracken is present in Britain so that future spread can be detected and measured.

The first problem is being tackled in two ways, by literature search and discussing the problem with agencies interested in the bracken problem. The second problem is crucial to developing methods for both assessing distribution/spread and devising good methods for control. However, bracken control is essentially a long-term problem - taking a minimum of 5 - 10 years for good heath/moorland vegetation to develop. Thus, to develop an effective policy it is essential to have a combination of (a) long-term experiments, (2) chronosequence studies, and (3) modelling. We are using all three approaches together to develop an effective understanding of the bracken plant and the effect of control strategies. The third problem is being tackled in conjunction with the Countryside Survey currently being undertaken at ITE, Merlewood.

The original contract envisaged the study being done under 4 sub-projects; progress in each is given below.

OBJECTIVE 1: Literature review of the pluses and minuses of the bracken habitat

Most of the background work for this part of the project has been completed. This has included a computer search of recent literature of over 800 publications, as well as a desk review of earlier work. There is still a need for some consultation with other interested bodies, which is continuing and should be completed by the end of November. We are also in the process of collating data on bracken communities from the National Vegetation Classification survey, and this aspect should be completed by the end of September.

Progress: There is no obstacle to producing this part of the contract report by March 1991.

OBJECTIVE 2: Field studies

There were two original aims for this part of the project, these were:

(a) To continue and expand our ongoing work on the biology of bracken in Breckland. This work was started in 1978 and has been monitored through until 1990. The original aims were to measure the success of a range of bracken control strategies as part of a heathland revegetation programme.

(2) To start some new studies in an upland area so that the reliability and generality of the conclusions derived in our detailed studies in Breckland could be tested.

Progress on the Breckland experiments has been considerable. Eighty percent of the data has been completely re-analyzed and several general principles concerning bracken assessment/monitoring, bracken control, and vegetation restoration have been derived. The remaining 20% of the work which remains to be analyzed was either collected in 1990 or is part of a sub-study of carbohydrate and bracken rhizome characteristics. The remaining unanalyzed data will form part of the modelling initiative next year.

As all of our data on bracken rhizomes have been collected at varying time intervals after the start of the experiments a new experiment measuring effects of bracken treatments on bracken rhizome characteristics was started this year. Our aim here is to collect information at frequent intervals from stands undergoing the initial stages of bracken control for modelling purposes.

We chose the North York Moors to study bracken in upland Britain. This area was chosen, partly because there has been extensive bracken control done over the last decade, and partly because it was included in the NRSC report to DOE (Smith & Wooding, 1989). Here a chronosequence approach has been adopted, comparing (1) bracken recovery and (2) moorland/grassland regeneration at varying times since treatment by asulam.

A major emphasis this year has been the collection of data that will help us to understand the mechanisms through which bracken is affected by control treatments and more importantly how it recovers. The answer to these problems lies in the rhizome. We have to understand how control treatments affect (1) the 'food storage' in the rhizomes, (2) the rate at which these resources are used up, and (3) the numbers of active buds - foci for new frond production. Thus, we have made measurements of rhizome

biomass, the numbers of frond buds, the respiration rate of the rhizome, and over the winter we shall measure the amounts of carbohydrate in the rhizome tissues. These data will be collected from all new experiments.

Progress: Data on bracken regeneration and heath/moor vegetation establishment will be available in draft form by March 1991 - Data will also be available to start development of computer model in April 1990 - see below

OBJECTIVE 3: Model development

The original objective of this part of the project was to synthesise our Breckland data with new information from upland areas into a computer model which could be used to make predictions about the effectiveness of different treatments in the short and more importantly the medium- to long-term. Many experiments have been done in the first few years after bracken treatment, but there is limited knowledge about the changes thereafter. It was hoped that by bringing existing information together, identifying and plugging gaps in our knowledge, we would be able to develop simple simulation models.

This year we have brought together several datasets which will be used in model development and identified several gaps. The main areas where additional knowledge is needed is about the role of the bracken rhizome, the amount of 'food' reserves held there, the rates of utilization of the reserves, and the dynamics of bud populations. The information we have collected will go some way to plugging these gaps.

Progress: Data collection continuing, computer modelling will start in 1991

OBJECTIVE 4: Assessing the distribution and spread of bracken

In this part of the contract we were asked to supply advice to ITE's Countryside Survey 1990 with the aim of trying to improve our knowledge about the areal extent of the bracken problem. There is great debate on both the extent of the bracken area, and this makes it extremely difficult to estimate rates of increase/decrease.

Problems in making assessments of bracken area:

(1) Is bracken under trees to be assessed? The answer to this question is crucial to determining methodology. If there is no interest in bracken under trees then remote sensing can be used to identify areas of dense bracken. If remote sensing is used there is a problem with assessing bracken encroachment later if cleared woodlands are not identified.

(2) Are areas of sparse bracken important? Dense bracken stands can be picked up by remote sensing, but this method cannot pick up bracken frond densities are low. This means that for the measurement of bracken encroachment the only criteria that count are parcels of land that exhibit the following trajectories:

Dense bracken (>T) ---> Dense bracken (>T)

Dense bracken (>T) ---> No bracken (<T)

No bracken (<T) ---> Dense bracken (>T)

The first shows no change, the second a loss and the third encroachment. However, this interpretation is extremely simple and may give completely wrong assessments of encroachment. Much land which would be picked up as loss or encroachment will be moving from above to below (or vice versa) the bracken density at which remote sensing picks up bracken. It does not come from or go to zero. Thus, in order to determine true encroachment rates it is essential to have some estimate of sparse bracken. It is difficult to detect sparse bracken when the resolution of remote sensing is 30m x 30m.

(3) Is bracken in linear habitats important? Bracken is a common feature of hedgerows, wall margins and roadsides. It is often prevented from encroaching into fields by management. If this management were to be relaxed there is a potential spread from these infection foci, particularly where the management regime has been relaxed; eg under Set Aside or Farm Forestry schemes.

Thus, the Countryside Survey teams have been instructed to study bracken in greater detail than was originally intended. They are going to map in each of the 512 1 km² survey squares the area of dense bracken (defined as continuous areas with a closed bracken canopy), and the area of sparse bracken (defined as areas containing scattered fronds). Bracken under tree canopies will also be studied. In addition, bracken will be monitored in the quadrats across linear features. This survey strategy was the optimum one giving maximum information for the resources available.

Thus, for the first time there should be an accurate assessment of the bracken stock for Britain - we will have a measure of dense bracken patches, bracken under trees, sparse and linear-feature bracken which may represent a threat in the future. This information can be modelled under various scenarios to predict the outcome of policy decisions. Moreover, it will be possible to link this information with data collected under the DOE contract to map the vegetation of Britain and that collected from remote sensing sources such as the NRSC report (Smith & Wooding, 1989) using GIS technology.

Progress: data are being collected during 1990 and will be available for analysis in late 1990-early 1991.

REFERENCES

Smith, S.M. & Wooding, M.G. (1989). Mapping bracken in England and Wales from Satellite Imagery: a feasibility study. (Report to DOE from NRSC).

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