

THE NATURE CONSERVANCY

COMMITTEE FOR ENGLAND

Moor House, Westmorland: 3rd Progress Report 1961/62

by M. Rawes and D. T. Crisp

GENERAL

The staff in post on 30th September, 1962 were as follows:-
M. Rawes (Officer-in-Charge), J. M. Nelson (Zoology and Climatology),
D. Welch (Botany), T. L. Hodgson (Warden), Mrs. E. Steele (Housekeeper)
and R. W. Martin (Estate Worker). Dr. D. T. Crisp, based at Merlewood but
working also at Moor House, was Deputy to the Officer-in-Charge. E. J. White
was transferred to Merlewood on 27th August, 1962, his climatological duties
being taken over by J. M. Nelson who moved to Moor House from Merlewood on the
same date.

A. SCIENTIFIC RESEARCH

I. Climatology - Mr. E. J. White and Mr. J. M. Nelson

Observations continue to be made.

II. Vegetation

The influence of management on the grasslands of Moor House - Mr. M. Rawes and Mr. D. Welch

(a) Measurement of changes in vegetation and soil following the removal of grazing

A comprehensive botanical analysis of the three summit grasslands was completed in August. This work has involved the repetition of the 1955 point quadrats which were set out in each enclosure. An additional 1,000 points were recorded on the grazed grassland of each site, as controls.

Preliminary examination of the data supports the visual observation of an increase in grass cover, particularly of *Deschampsia flexuosa*. Increased growth, however, has resulted in fewer species being recorded, and, furthermore, a decline in frequency of some plants, principally bryophytes and lichens.

Measurements of herbage yield and litter build-up after 7½ years of enclosure have been made. Soil samples, taken to increase the meaningfulness of the original (1955) analyses, were obtained in 1961. No chemical estimations have been made on the material to date.

(b) The establishment of natural grassland communities

Other than continuing observations no measurements have been made this year.

(c) An experiment to raise the productivity of limestone grassland

Hay yields in the district have generally been very low this year, and the Moor House meadow has proved to be no exception. The sampling area gave a much lower yield than the average of the three preceding summers, whilst the pasture enclosure also produced less. Yields in lbs. of dry matter per acre for the last four years have been as follows:-

	Meadow	Pasture
1959	3803	1885
1960	3205	2744
1961	3456	2518
1962	2653	1917

(d) The productivity of grasslands in relation to sheep grazing

This year we have obtained information on the general distribution of sheep flocks throughout the Reserve; built up records of sheep numbers and their management; obtained the names of commoners exercising their rights and assessed the degree of grazing pressure in a general way. For instance the western escarpment supports at least one sheep to the acre during the summer, whilst the remaining 7,000 acres of the Reserve have probably no more than 1,500 sheep. Furthermore we have established that although heafs exist there is considerable intermingling of flocks and little shepherding takes place to encourage the heaving instinct.

A closer examination has been made of three high-level grasslands, on sites adjacent to the Knock Fell, Little Dun Fell and Hard Hill enclosures. Here we have measured the grazing intensity and herbage intake by sheep, as well as the year's production of grass. Grazing intensity has been obtained by recording sheep numbers seen within a defined acreage. Over fifty observations per site were made each month. Herbage intake has been assessed by the difference in dry weight yield of grass cropped from temporarily enclosed grassland and from the grazed sward alongside. The cages, used for this temporary enclosure, were moved to fresh ground each month. The August harvesting of grassland enclosed for the summer has given us the seasonal herbage production for each site.

(e) The establishment of high-level woodland - Dr. A. Carlisle, Mr. A. H. F. Brown, Mr. E. J. White

i. Species Trials

The species trials at Green Hole (1900 ft.), Force Burn (1700 to 1800 ft.), Nether Hearth (1800 ft.), Rough Sike (1850 ft.) and the Pasture Plot (1850 ft.) were continued. Where the trees have been destroyed by rabbits and voles, in Rough Sike, these were replaced with Alder (Alnus glutinosa) and Birch (Betula spp.). In these trials to determine which species can withstand the difficult climatic and edaphic conditions of the Reserve, it is apparent that Lodgepole Pine (Pinus contorta) is the most successful tree on the exposed peat areas, and the provenance of the trees is of major importance. For example, the Scots Pine (Pinus sylvestris) originating from Raasay has mainly died, while those from north eastern Scotland have survived. A few (200) Sitka spruce (Picea sitchensis) of Alaskan provenance were planted and are growing well, in contrast to those from Queen Charlotte Island which are growing very slowly. The use of larger Willow (Salix sp.) "truncheons" has given much better results than smaller shoots which rooted only with difficulty. It is clear from these trials that although indigenous tree species such as Scots Pine, Birch and Rowan can be grown on this difficult site given shelter, no indigenous tree species can survive the conditions of the exposed peat areas without shelter. If indigenous tree species are to be established on the exposed sites, it will be necessary to grow them in the shelter of hardier introduced species. Means are therefore being sought to establish Lodgepole Pine on exposed peat areas with a view to growing indigenous species in its shelter.

ii. Tree Nutrition

In the spring of 1962 a fertilizer trial was initiated to find the best means of establishing Lodgepole Pine on the exposed blanket peat of the Reserve. A two acre plot was ploughed, fenced and planted with Lodgepole Pine, and the trees treated with different types and combinations of fertilizers, with the co-operation of the Forestry Commission. The growth and nutrient content of the trees will be recorded over a period of several years.

The Scots Pine growing on the blanket peat at Green Hole have been showing signs of chlorosis for the past two years, and their growth is significantly less than that of trees of similar age on the nearby redistributed peat. Leaf analysis has shown that the chlorotic trees are deficient in potassium. In the past it has been customary to dress each tree planted on the blanket peat with Ground Mineral Phosphate, which contains both phosphorus (13.8%) and calcium (32.4%). It is possible that the potash deficiency is due to the addition of calcium, and this calcium/potassium relationship is being investigated.

(f) Plant nutrition studies on peat - Mr. A. J. P. Gore

Factors limiting plant growth on peat

The results of the first experiment comparing growth of Molinia on peat at Moor House with growth of similar plant material at sea-level have been analysed and a further part of the series "Factors limiting plant growth on high-level blanket peat" is almost completed. This is "III. An analysis of the growth of Molinia caerulea L. Moench. at two different altitudes".

(g) Productivity of Blanket Peat Vegetation - Bog Hill
Mr. A. J. P. Gore

A study of productivity and sensitivity to different cropping regimes of blanket peat vegetation is continued. The observations on the fourth year have been completed. The first cycle of these observations will be completed in 1963.

(h) A vegetational survey of the Moor House National Nature Reserve -
Professor D. H. Valentine

Mr. Eddy has now completed his survey of the Reserve; a detailed vegetational map, in colour, has been prepared, together with full lists of all the vegetational types recognized. In addition Mr. Eddy has carried out work on the vegetational zonation and physical conditions (including water analyses) of the bryophyte flushes in the higher parts of the Reserve. Herbarium specimens of the plants of the Reserve (including bryophytes) have been deposited at Moor House.

A full account of the work is being prepared by Mr. Eddy in the form of a Ph.D. thesis.

(i) The autecology of Juncus squarrosus - Professor D. H. Valentine

Mr. Welch has made extensive seed collections from a series of Juncus populations at various altitudes in the Moor House area, and has obtained detailed results on germination and reproductive capacity. He has studied the morphology of mature plants and is working out the developmental history of the plant from seedling to maturity. He also began work on the structure of Juncus colonies in various habitats, and is carrying out preliminary experiments on the growth of seedlings on peat and mineral soils.

(j) Long-term investigation on effects of burning - Dr. R. J. Elliott

In August 1964, as part of a study of the long-term effects of burning on site productivity, the species composition and cover was

recorded in each of the twenty-four and one tenth of an acre plots of this experiment. Samples of vegetation and soil were collected from the plots for chemical analysis.

One third of the plots are to be burned every seven to ten years, one third every fifteen to twenty years and the remainder to be kept unburned as controls.

(k) Laboratory scale burning experiments - Mr. S. E. Allen

The object of these experiments is to determine the availability of chemical nutrients following heather burning. An attempt is being made to do this with small scale experiments intended to be complementary to the field experiments carried out by H.F.R.O., and already in operation at Moor House.

III Fauna

(a) Durham Colleges Zoology Department - Dr. J. C. Coulson

Students from the Durham Colleges, under the supervision of Dr. J. C. Coulson have continued to make full use of the Reserve for ecological studies.

i. Studies on the biology of moorland Collembola - W. G. Hale

Work on the Collembola (Springtails) of Moor House has been in progress since September 1959, and has been divided into two major categories:

- 1) Population studies carried out by regular sampling of limestone grassland, alluvial grassland, heather litter, Juncus squarrosus grassland and several microhabitats within the erosion and recolonisation complex of blanket bog.
- 2) Laboratory culturing affording information on the biology of several moorland species.

A Ph.D. thesis is in the course of preparation and a paper is in press:

The Collembola of eroding blanket bog. Proceedings of the Colloquium on soil fauna, soil microflora and their relationships. Oosterbeek, Holland, 1962.

ii. Studies on the Auchenorhynca (Hemiptera : Insecta) of Pennine Moorland with special reference to the Cercopidae - J. B. Whittaker

General sampling of the group has been made by sweep-netting and by the use of a portable electric suction trap on Festuca-Agrostis grassland, actively growing bog, mixed moor and various specialized vegetation types.

Regular sampling has also been carried out in areas representative of Juncus squarrosus moor, Nardus grassland and Festuca-Agrostis grassland, to study the life history and host plant relationships of two Cercopidae.

The effect of altitude on one of the Cercopidae species has been studied and temperature and humidity gradients in various vegetation types have been studied and related to the different numbers and species of Auchenorhynca found.

Some 30 species of Auchenorhynca have been taken on the Reserve.

iii. Studies on the Acarina of Moorland Areas: 1960-62 - W. C. Block

Quantitative sampling for soil-dwelling mites (Acarina) has been

carried out by means of a high gradient extraction apparatus for the following sites at Moor House: Festuca-Agrostis grassland, mixed moor litter layer, Nardus grassland, alluvial grassland, Juncus squarrosus and the Moss Flats erosion complex.

A total of 92 species of soil mites have been recorded to date: 54 species of Cryptostigmata (Oribatei), 36 species of Mesostigmata, and one species each of Astigmata and Prostigmata. Seasonal fluctuations, both of the total numbers of soil mites and of the individual species, are being examined. Densities ranging from 10,000 to 160,000 per sq. m. have been recorded and estimates of biomass are being obtained.

The life histories of the commoner oribatid and gamasid species of the peat and mineral soil areas are being worked out from field data, where possible, and in laboratory cultures.

iv. Biological studies on Enchytraeidae (Annelida) - Josephine Springett

During the past year a study has been made on the numbers and species composition of Enchytraeidae in different soil habitats on the Moor House National Reserve, Westmorland.

Quantitative soil samples have been taken at five sites: Mixed Moor, Nardus grassland, Juncus squarrosus, and Limestone grassland and Bare Peat. These were extracted and the numbers, size, vertical distribution and the proportion of mature Enchytraeidae recorded. These data gave an indication of the population fluctuations and of the life cycles in the field. Laboratory cultures are being set up to obtain more detailed information on the breeding biology of the animals.

A wider range of habitats has been sampled qualitatively and 20 identified species belonging to 8 genera recorded. There are marked differences in the species compositions of mineral and peaty soils.

A paper is in press:

The distribution of three species of Enchytraeidae in different soils. Proceedings of the Colloquium in soil fauna, soil microflora and their relationships. Oosterbeek, Holland, 1962.

v. In addition P. B. Springett has started work on the distribution of burying beetles (Necrophorus) and is collecting material from the Reserve.

(b) The ecology of testate amoebae in Sphagnum - Dr. O. W. Heal

An account of the research carried out on this subject whilst Dr. Heal held a Nature Conservancy Research Studentship at Durham, has been published. The investigation continues on a limited scale.

(c) The Cladocera of the Moor House National Nature Reserve -
Dr. O. W. Heal

A brief survey of the Cladocera on and near the Reserve has been completed and an account is now in press.

(d) The Ephemeroptera of the Moor House Nature Reserve -
Dr. D. T. Crisp and Mr. J. M. Nelson

During 1962, qualitative sampling for Ephemeroptera nymphs was made in most streams of the Reserve and a number of imagines were also collected. The aim is to obtain a species list for the Reserve together with information on distribution between streams and on distribution with respect to altitude and to the conditions within the different parts of the streams.

IV Hydrology

(a) Studies on selected catchments - Mr. A. J. P. Gore

The hydrological work connected with reclamation studies is at present deferred until staff and money become available.

(b) The hydrology of upland areas - Mr. V. K. Collinge

Mr. Collinge is using the Trout Beck catchment as one of three areas for an investigation of the hydrological characteristics of three upland areas which differ widely in soil and vegetation cover.

A grant of £2,234 was made by D.S.I.R. in May, 1962, towards this work. The work so far has been to design additional rain gauges of unusual types and establish them at the upper end of the Trout Beck catchment. This work has been reported in a paper at the Water Research Association Symposium "Measurements in Hydrology".

(c) The effects of streams on the productivity of Moorland - Dr. D. T. Crisp

An experiment has been set up in Rough Sike to investigate:-

- 1) Downstream drift of aquatic animals, peat, vegetation and nutrients in solution.
- 2) The quantity of terrestrial animal material entering the stream from the surrounding moorland.

Apparatus has been set up which, in conjunction with a metering weir, will give estimates of both these quantities. Routine sampling began in May, 1962 but, in the light of experience gained during floods in August, it became clear that some modification was necessary before the apparatus could work satisfactorily under flood conditions. These modifications are now almost completed and should facilitate measurement of the large quantities of peat being carried by the stream in times of flood.

V Soils

(a) Respiratory activity of moorland soils - Mr. J. B. Cragg

Investigations on the respiratory activity of moorland soils have been hampered by lack of apparatus but the preliminary stages in the investigation have now been completed. Marked differences in the respiratory rates between different soils and in the profiles of individual soils have been recorded and to some extent can be related with the level of microbiological activity characteristic of these soils.

(b) Fungi and Bacteria associated with moorland sites - Miss P. M. Latter

A preliminary semi-quantitative survey is in progress on the fungi, yeasts and bacteria associated with those sites at Moor House which are being used for investigations on the soil fauna. At least thirty-six species of fungi have been recorded and some measure of their availability for the microfauna is being obtained.

Total numbers of bacteria (direct counts) of the order of 10^9 - 10^{10} /g. (dry wt.) occur in limestone and Juncus squarrosus sites with 10^8 /g. (dry wt.) on bare, redistributed peat. A large proportion of the organisms in the bacterial counts are large cells as yet unidentified. They form up to 25 per cent of the counts in limestone soils.

Miss L. Bower (Royal Holloway College, London, Ph.D. student)
Ecology and experimental taxonomy of Philonotis spp.

Brathay Exploration Group
Survey for the Land Utilisation Survey.

VIII Publications

- Bower, M. M. (1961) The distribution of erosion in blanket peat bogs in the Pennines
Institute of British Geographers. Transactions and Papers
Publ. No. 29.
- Bower, M. M. (1962) The cause of erosion in blanket peat bogs.
A review of evidence in the light of recent work in the Pennines.
Scot. geogr. Mag. 78, 33-43.
- Cragg, J. B. (1961) Some aspects of the ecology of moorland animals.
J. Anim. Ecol. 30, 205-234.
- Crisp, D. T. (1962) Some Corixidae (Hemiptera and Heteroptera) from bog and moorland waters. Trans. Soc. Brit. Ent. 15, 21-28.
- Grant, S. and Hunter, R. F. (1962) Ecotypic differentiation of Calluna vulgaris (1) in relation to altitude. New Phytol. 61, 44-55.
- Heal, O. W. (1962) The abundance and micro-distribution of testate amoebae (Rhizopoda : Testacea) in Sphagnum.
Oikos. 13, 35-47.
- Jordan, A. M. (1962) Coleophora alticolella Zell. (Lepidoptera) and its food plant Juncus squarrosus L. in the northern Pennines.
J. Anim. Ecol. 31, 293-304.
- Park, K. J. F., Rawes, M. and Allen, S. E. (1962) Grassland studies on the Moor House National Nature Reserve.
J. Ecol. 50, 52-62.
- Swinscow, T. D. V. (1958) An Arctic-Alpine lichen new to England.
Lichenologist. 1, 29-30.

B. ESTATE WORK

There having been no financial provision for estate work, no improvements or repairs have been done except when materials existed in stock.

(a) Roadworks

During the year pot-holes occurring on the access road have been repeatedly filled with gravel but there are now large stretches where the bitumen surface has been removed entirely. Work other than first-aid repair by the estate staff is needed to save heavier expense in the years to come, both on vehicles and road re-surfacing.

A considerable tonnage of stone has been led to surface the Trout Beck track.

Retaining walls by the River Tyne have been repaired and further culverts laid beneath the access road. The road drainage is now sufficient to cope with all but the very heaviest downpour.

To permit delivery of a Forestry Commission low-loader, the top

of the Snead was removed by blasting. Mr. Beadle contracted to lower this hazard some three feet.

(b) Moor Burning

No heather was burnt this year.

(c) Hay Meadow

The crop was cut and harvested in August. Half a ton was purchased from the Warden.

(d) Enclosures

Repairs to the summit ridge grassland enclosures became necessary. All the wire on the top side of Little Dun Fell large enclosure was replaced. 2" mesh 16 gauge wire netting was added to the existing Nether Hearth enclosure. This will keep out sheep which have been gaining entry, and also give some protection to the trees from rabbits.

The Tees-side grassland enclosure was dismantled and materials stacked nearby for possible future use.

A two acre enclosure N.W. of Bog Hill was erected for the Merlewood Forest Botany Section. Previously the site had been moor-gripped by the Forestry Commission with a Cuthbertson plough drawn by a County Track-layer.

(e) Winter

Severe frost in December caused the complete freeze-up for three weeks of the domestic water supply. Wooden covers have been made for the settling tanks up Rough Sike and this should reduce future risk.

Access by road to Moor House was blocked by snow drifts from 27th February to 5th April. Drifts were as long and as deep as can be remembered.

(f) Trout Beck Gauging Station

The Wear and Tees River Board have reconstructed their weir to improve the range and accuracy of the recordings and to lessen the accumulation of silt and shingle in the pool.

(g) Wardening

Pest Control: One fox cub was killed on the eastern side of the Reserve. Several rabbits have been trapped close to the house.

C. PUBLIC RELATIONS

Isolated cases of interference with property have occurred in the past year. Thermometers placed on Knock Fell were found, a week after installation, to have been broken or removed.

Visitors to Moor House included:-

Mr. Charles Elton

- Mr. F. K. P. Pentelow (Chief Fisheries Officer, M.A.F.F.), and
- Mr. I. G. Simmonds (University College London)
- Dr. K. Mellanby (Monks' Wood)
- Mr. J. R. Rundle and party (Regional Land Commissioner, Yorks. and Lancs. Division)
- Mr. F. H. W. Green and Mr. I. Smith (Nature Conservancy, Speyside)
- Mr. H. T. D. Holgate (Meteorological Office)
- Mr. D. J. Pratt (Pasture Research Officer, Kenya)
- Dr. R. F. Hunter, Mr. I. A. Nicholson, Mr. J. Eadie (H.F.R.O.)
- Dr. J. C. Rodda and Dr. J. V. Sutcliffe (Hydraulics Research Institute, Wallingford)