AN INVESTIGATION INTO THE EFFECTS OF AGRICULTURAL MANAGEMENT PRACTICES ON THE SOIL OF THE SOMERSET PEAT MOORS

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SUMMARY

Three fields, which are managed at different levels of 'improvement', were compared in terms of their soil profiles, bulk densities, organic carbon contents, total nitrogen contents and pH values. With the exception of the latter measurement, significant differences in these properties were found between the three fields. The differences were mainly related to peat decomposition, which is thought to be influenced predominantly by the height of the water table and the amount of available nitrogen in the peat.

KEYWORDS

Somerset Peat Moors, humification, peat decomposition, drainage, carbon:nitrogen ratio.

INTRODUCTION

The Somerset Moors are an area of topogenous fen peat (Ratcliffe 1977) which extends across the flood plains of the Axe, Brue, Parrett and Huntspill rivers and the Kings' Sedgemoor Drain (Somerset County Council 1984). Traditionally the land has been allowed to flood in winter and then used later for dairying, under permanent pasture or as hay meadows (Soil Survey 1955). These methods of farming encouraged a rich diversity of flora and fauna, making the Moors an important wetland area. In recognition of this fact, parts were designated Sites of Special Scientific Interest (SSSIs) after the Wildlife and Countryside Act of 1981, and in 1986 most of it was made an Environmentally Sensitive Area (ESA) to maintain the wetland and the traditional farming practices. Since the Second World War the conservation value of the Somerset Moors has been under threat. EEC and government incentives to farmers encouraged attempts to increase food production by 'improving' land through drainage, fertilizer application and cultivation. The Strutt Report (MAFF 1970) estimated that 77% of the Moors, if under-drained, would be suitable for arable farming. Measures such as these have serious implications for the long-term existence of the peat.

When farmed intensively, peat has been described as a continually wasting resource (Avery 1990) which, according to Eyre (1968, 91), 'cannot possibly survive improvement and cultivation'. This type of change can already be seen in the East Anglian fens where, as a result of drainage and cultivation, erosion and peat wastage continue at rates of 0.5–3 cm per year (Avery 1990), in some areas exposing the underlying strata or skirt (Hutchinson 1980).

The purpose of this study is to examine how farming practices, particularly those which aim to increase agricultural productivity, have affected the peat on the Somerset Moors. Although farmers are now encouraged to revert to more traditional methods under ESA agreements, many people consider that the conservation value of the moors is still deteriorating, largely through a failure to maintain the water table at a sufficiently high level (Williams 1989; Davies and Housden 1990).

METHODS

A comparison was made of selected properties of the soil taken from three fields on the Catcott, Edington and Chilton Moors SSSIs (Fig. 1). All the fields lie below 10 m OD and all are situated on the Sedgemoor Organic Soil Series, which is predominantly a eutrophic (alkaline or neutral) peat, 0.6–3 m thick, overlying clay (Soil Survey 1955). The management practices of each field can be thought of as representing a scale of 'improvement', one being a traditional hay meadow, one a permanent pasture partially 'improved' by artificial fertilizers, and the third converted to an arable/ley rotation.

The first site, known as Chapman's Field (ST 406415) is 0.8 ha in area and forms part of the Catcott North Reserve, owned by the Somerset Trust for Nature Conservation (STNC). Since 1980 it has been managed as a traditional unimproved hay meadow and is no longer grazed. As far as is known, it has never been re-seeded and no fertilizers or herbicides have ever been applied. The water table on the whole reserve is penned in an attempt to keep it near the surface all the year round (Hancock, pers. comm.). The field once flooded regularly in winter but this no longer occurs.

The second field, owned by Mr Cox, is situated on Chilton Polden Moor, at ST 379422, approximately 2.5 km west of Chapman's Field. It is 1.5 ha in extent. Under a management agreement with the Nature Conservancy Council (NCC, now English Nature) drawn up in 1987, the field is maintained as permanent pasture. After a silage crop in spring, cattle graze the field on alternate months as far into the winter as weather permits. The annual amount of fertilizer is restricted to 500 kg ha^{-1} of a 20:10:10 formulation. Half of this is applied at the end of April and the rest in early August. No lime is added. The water levels in the ditches are controlled by the Internal Drainage Board and the field floods occasionally in places in winter (Cox, pers. comm.).

The third field, 6.6 ha in area, is on Catcott Moor at ST 412418, approximately 0.7 km north-east of site 1. Prior to August 1990 it was owned by Mr P. Gibbons. In 1977 the field was 'improved' with the installation of a pipe drainage system and from 1979–89 was under arable crops. In April 1990 it was sown with a temporary grass ley. One hundred units of nitrogen, 185 of phosphorus and 250 of potassium per hectare were applied to the seed bed in April, with a further 200 N, 100 P and 220 K after the silage crop was taken at the end of July (Gibbons, pers. comm.). This field has since been purchased by the STNC.

In order to obtain descriptions of soil profiles, pits, up to 50 cm deep, were dug in Cox's and Gibbons' fields at sites considered to be representative. To avoid disturbance in Chapman's Field, a pit was dug under alder/willow carr on the neighbouring Catcott Heath Reserve, where there is a similar moisture regime. The degree of humification of

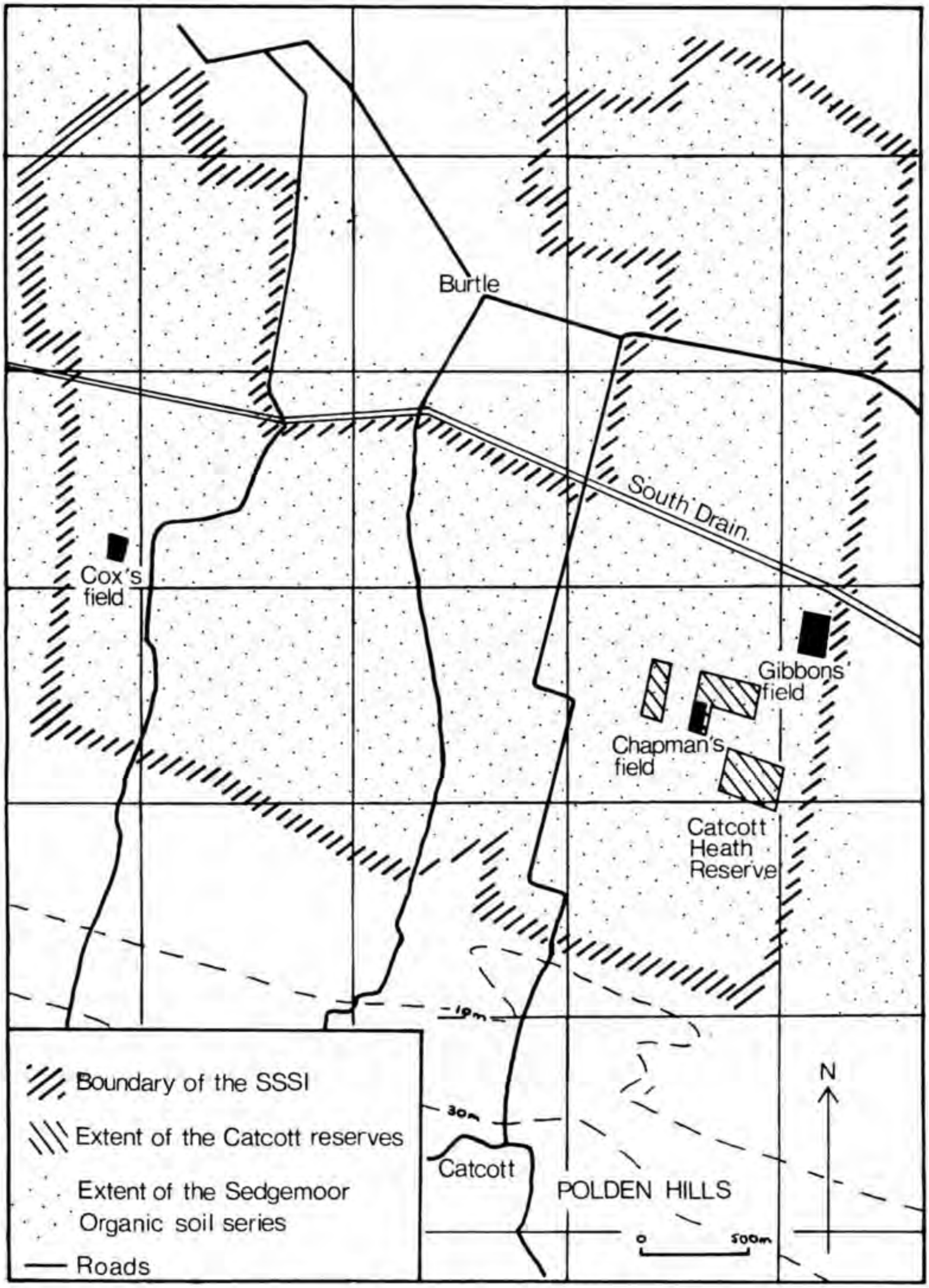

Fig. 1 Location map. National Grid kilometre grid squares are superimposed.

the peat was estimated using the von Post scale of peat decomposition (Fitzpatrick 1980) in which lower figures indicate more decomposed peat.

Soil samples for analysis were taken in mid-July 1990 from six further pits, approximately 20 cm² in area and 30 cm deep, in Chapman's, Cox's and Gibbons' fields. The location of the pits was determined using a random sampling method (Bolas 1990). Samples, each of about 25 g, were taken from two depths in each pit, namely from 10–15 cm and from 20–25 cm below the surface. The first depth was judged to be just below the level of the bulk of the plant roots, while the second was sufficiently distant from the first to allow changes with depth to be detected and yet practical to collect.

The soil was air-dried and then passed gently through a 2 mm sieve. Samples were then analysed for the following:

i. pH, on a 1 : 2.5 soil : water suspension;
ii. organic carbon content, by wet oxidation;
iii. total nitrogen content, by a mico-Kjeldahl method.

For details of the methods used *see* Hesse (1971).

Bulk density was determined on undisturbed samples collected from just below the root material at three sites in each field. The amount of variation between the results was determined using the Kolmogorov-Smirnov significance test, a non-parametric test suited to evaluating significance levels between small data sets (Siegel 1956).

RESULTS AND DISCUSSION

The soil profiles are described in Appendix 1. In all three areas, horizon boundaries were recognised at depths of approximately 10 cm and 20 cm. An additional boundary at 45 cm was seen in the Catcott Heath Reserve profile. These observations correspond approximately with the findings of the Soil Survey (1968, 124) in which boundaries in the Sedgemoor Organic Series were identified at 5–8 cm, 23–30 cm and 50 cm depths. The nature of the surface peat in Catcott Heath Reserve differed markedly from that in Cox's and Gibbons' fields. In the former, the peat had retained much of its moist crumb structure, but the latter two sites had hard, dry, granular peds which did not rehydrate when wetted, plus some dusty material. Avery (1990) describes this type of peat as an 'earthy top-soil' and ascribes its formation to peat humification and dehydration. It is a condition which is very difficult, if not impossible, to reverse (Soil Survey 1955; Avery 1990). The peat in the Catcott Heath profile became less decomposed and more moist with depth as the influence of the ground water became stronger. In Cox's and Gibbons' fields it was not possible to identify any buried plant remains other than resistant twigs, and the lamination of the peat had been destroyed by ploughing in Gibbons' Field. In Catcott Heath, however, remains of aquatic plants and trees were identifiable below 20 cm and were present in distinct layers.

Soil pH

The results of the soil pH determinations are given in Table 1.

Table 1. Soil pH, (arithmetic mean values, with standard deviations in brackets)

Sample Depth cm	Chapman's Field	Cox's Field	Gibbons' Field
10–15	5.90 (0.16)	6.27 (0.20)	5.97 (0.24)
20–25	5.82 (0.11)	6.37 (0.16)	6.03 (0.27)

There are no significant differences in the pH values either between any of the fields or at any depth, showing that, in this instance, pH is not altered by cultivation. The range of values obtained is lower than expected, because the ground water in this area, coming from the limestone of the Polden Hills, has a high base content, and should thus raise the pH of the peat to neutral or alkaline (Soil Survey 1955). The slightly acidic pH of the soil could be due to a reduction in the influence of the ground water in the surface layers through drainage and subsequent leaching. Possibly at greater depths, the peat is alkaline.

Bulk Density

The mean results of the bulk density determinations (three samples per site) are shown in Table 2.

Table 2. Bulk Density (gcm^{-3}), (mean values and standard deviations).

Location	Bulk Density	Std. Dev.
Chapman's Field	0.23	0.02
Cox's Field	0.48	0.14
Gibbons' Field	0.39	0.12

The bulk density of the soil in Chapman's Field is significantly less ($p < 0.01$) than the other two. Bulk density is a measure of compaction: the lower the figure, the less compact the soil. Factors which may account for the differences between the three fields could include: organic matter and moisture content at the time samples were taken; trampling by cattle; and the frequency of use of farm machinery (Fig. 2).

Organic matter has the ability to retain moisture and thus has a large volume when it is wet. The bulk density of a sample which contains a high amount of organic matter is therefore likely to be lower than that of a sample containing largely mineral material. This could explain why the bulk density of Chapman's Field is lower than that of the other two. As has been seen, dehydrated peat is unable to re-absorb moisture easily and consequently its volume does not change markedly with soil moisture content. The bulk density of the soil in Gibbons' and, especially, Cox's fields, would be expected to be greater as a result of this (Avery 1990). Farm machinery is used more frequently in Cox's and Gibbons' fields than in Chapman's. In addition there may be the effect of trampling by cattle which graze Cox's Field for about three months each year. Trampling is known to cause considerable damage (Briggs and Courtney 1985), particularly on soils with a high organic matter content (MAFF 1983). The degree of soil moisture at the time of machinery use is also a contributory factor affecting the amount of damage caused by compaction (Briggs and Courtney 1985). In Cox's Field and, especially, in Gibbons' Field, there may have been the need to plant or fertilize early in the growing season, hence the likelihood that machinery was used on the fields when they were still wet. On peat soils, which take a while to dry out in the spring, this is a particular danger. In Chapman's Field, however, machinery is used only in late summer and, although the water table here is maintained at a higher level than that in the other two fields, damage at this time of year is likely to be less.

Organic Carbon Content

The results of the determination of the organic carbon content are given in Table 3.

Table 3. Organic carbon content (%), (mean values, with standard deviations in brackets).

Sample Depth cm	Chapman's Field	Cox's Field	Gibbons' Field
10–15	37.3 (4.0)	28.0 (3.0)	31.4 (3.9)
20–25	43.0 (2.9)	33.0 (5.8)	30.6 (5.4)

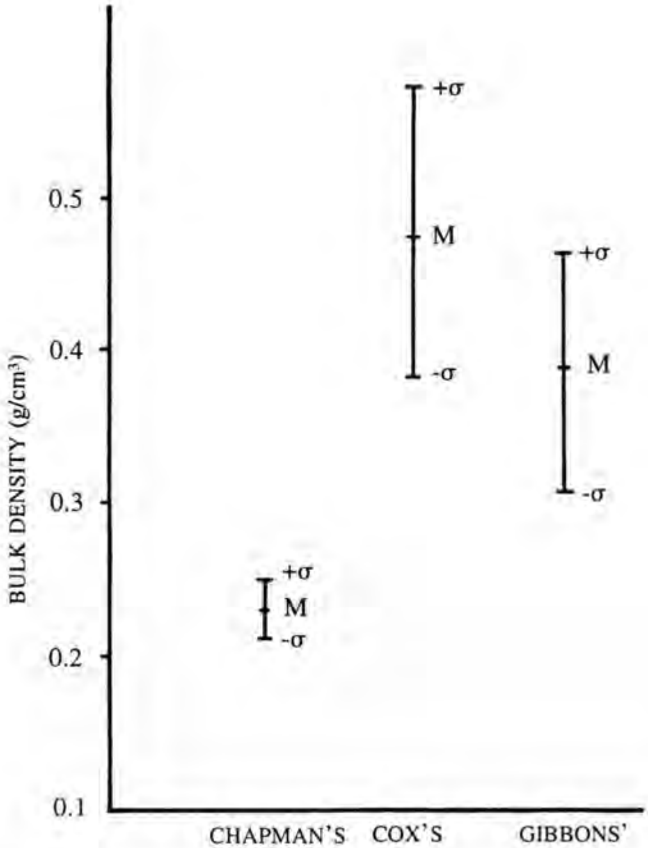

Fig. 2 Deviations of bulk density in Chapman's Field, Cox's Field, and Gibbons' Field (M = mean; σ = standard deviation).

At a depth of 10–15 cm, the organic carbon content of the soil in Chapman's Field is significantly higher ($p < 0.05$) than that in Cox's Field, although other figures do not differ significantly. However, at 20–25 cm, the mean values for Chapman's Field were found to be significantly higher than those of both Cox's ($p < 0.05$) and Gibbons' ($p < 0.01$) fields (Fig. 3). At every site in both Chapman's and Cox's fields, the organic carbon content increased with depth, although the extent of this varied. In Gibbons' Field, the difference with depth was small, except for one of the six sites where there was a large decrease. A cross-check using a different experimental method showed that this anomaly was due to experimental error. The non-organic (mineral fraction) in the soil possibly consists of silt

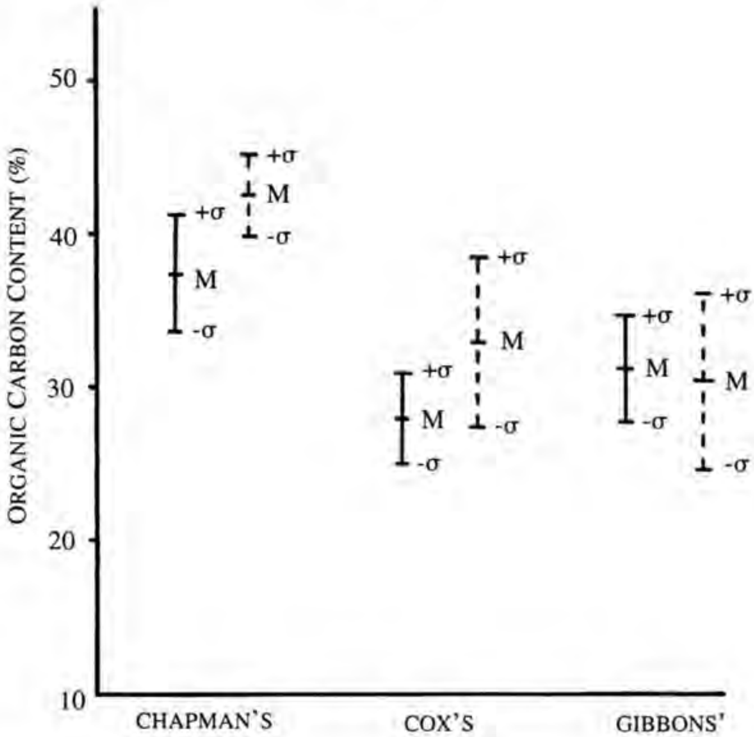

Fig. 3 Deviations of organic carbon content in Chapman's Field, Cox's Field, and Gibbons' Field (depths of 10–15 cm shown as solid lines; depths of 20–25 cm shown as broken lines; M = mean; σ = standard deviation).

and alluvium added by floods, and the varying organic carbon contents in the three fields could be explained by the varying degrees of flooding that each field has experienced. Both Cox's and Gibbons' fields flood occasionally in winter whilst Chapman's Field has not flooded for the last ten years. The differences on the von Post scale of humification in each of the fields, however, indicates that the differences in the organic content of the peat are more likely to be due to varying levels of decomposition.

Organic matter is decomposed by processes termed 'moulding' or 'biological ripening' (Jongerius 1962, in Avery 1990) which are dependent on soil fauna ingesting plant residues and exposing them to bacterial attack (Avery 1990). During these processes, which are aerobic, carbon is given off as carbon dioxide and water is produced (Gorham 1953) thus increasing the concentration of the mineral fraction in the soil. Soil fauna activity is affected by a variety of factors including oxygen tension, temperature, soil moisture content, pH, texture, and the presence of salts (Hesse 1971). Birch (1959, in Hesse 1971) believes field capacity to be the optimum soil moisture condition for organic decomposition. In water-logged soils, organic decomposition is reduced and occurs only slowly by the action of anaerobes (Hesse 1971). Arable land sown to grass is said to experience very rapid increases in organic matter content of the soil (Briggs and Courtney 1985) but it is unlikely that this would mask the effects of cultivation of

Gibbons' Field in such a short time. It is possible that, when Gibbons' Field was under arable crops, erosion of the loose surface peat by wind could have occurred. Less decomposed peat would then have been exposed at the surface thus maintaining the organic carbon content at a higher level than expected. In Cox's Field, which is permanent pasture, wind erosion is unlikely to have occurred and the proportion of organic carbon in the layers of peat sampled is likely to have been steadily reduced through decomposition. It is also possible that, due to the leaching of minerals from the soil, there is a lower limit of organic matter content in peat which is not exceeded despite cultivation. This is a factor which could be investigated further. The reason for the small change with depth in Gibbons' Field is hard to determine. Because cultivation goes hand-in-hand with drainage, it is difficult to separate the effects of each. It is possible that aeration of the peat by cultivation to a depth of 25 cm or more allows the organic matter to decompose to the same extent at this depth as it does at 10–15 cm. Alternatively, or in addition to the above, the underdrains and pumping systems installed in the field could give greater control over the water table. This would allow it to be either maintained at a low level for longer periods of the year and thus allowing oxidation at a greater depth, or allowing the peat to be kept at an optimum moisture capacity throughout the year, thus, as Birch suggests (Avery 1990), creating conditions which maximise organic matter decomposition. The rate of decomposition of organic matter is also dependent on the amount of nitrogen in the soil, which is vital to the functioning of soil microbes (Foth 1978).

Total Nitrogen Content

Inorganic fertilizers have been applied to both Cox's and Gibbons' fields regularly for at least the last ten years; therefore the total nitrogen content of these fields would be expected to differ markedly from that of Chapman's Field which, as far as is known, has had no direct input of fertilizers. However, the possibility of nitrogen leaching into the drainage water from surrounding fields must be borne in mind. Nevertheless it is convenient to consider the nitrogen levels in Chapman's Field as the background levels of this nutrient in the Sedgemoor Organic Series for use as a comparison with Cox's and Gibbons' fields.

At depths of both 10–15 cm and 20–25 cm, the level of nitrogen in Cox's Field is significantly higher ($p < 0.01$) than that in both Chapman's and Gibbons' fields (Table 4).

Table 4. Total nitrogen content (ppm), (mean values, with standard deviations in brackets)

Sample Depth cm	Chapman's Field	Cox's Field	Gibbons' Field
10–15	160 (26.6)	240 (19.9)	150 (24.2)
20–25	110 (16.3)	230 (26.4)	160 (15.1)

There is no significant difference between the nitrogen levels in the latter two fields at 10–15 cm. However, in Chapman's field there is a significant decrease ($p < 0.05$) in the nitrogen level with depth (Fig. 4). Possible explanations for this decrease with depth are, firstly, the inclusion of living roots in the soil samples taken at 10–15 cm, thus giving a deceptively higher estimation of nitrogen content (Waughman 1977), secondly, the addition of nitrogen at the surface from decomposing organic matter and thirdly, the effects of nitrogen fixation. Nitrogen fixation is thought to occur only in the top 20 cm of peat and is estimated to contribute 2.1 gm^{-2} yr^{-1} of nitrogen in rich fens, a contribution which exceeds that of rain water (Waughman 1977).

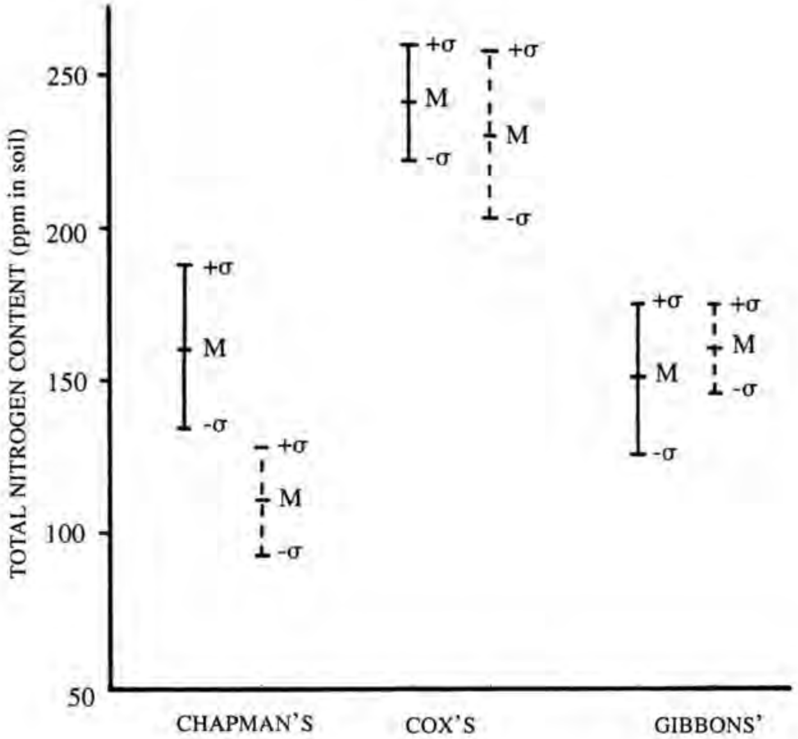

Fig. 4 Deviations of nitrogen content in Chapman's Field, Cox's Field, and Gibbons' Field (depths of 10–15 cm shown as solid lines; depths of 20–25 cm shown as broken lines; M = mean; σ = standard deviation).

The level of nitrogen in Gibbons' Field, approximately equal to that in Chapman's Field, suggests that the applied nitrogen fertilizer has been taken up almost completely by the sward. In Cox's Field, however, some of the applied nitrogen may still remain in the soil. A possible reason for this could be that the sward in Gibbons' Field contains particularly high-nutrient-demanding species, *Lolium* spp. and *Triticum* spp., which had been sown only three months before the soil samples were taken. Cox's Field also contains a high proportion of *Lolium* spp. but the plants are mature. Other less high-nutrient-demanding species such as *Deschampsia caespitosa* (L.) Beauv., *Elymus repens* (L.) Gould and, particularly, *Trifolium repens* (L.) (MAFF 1983) also form part of the sward (Bolas 1990), and nitrogen in excess of the plants' needs may therefore have been applied here. Nitrogen may also have been conserved in Cox's Field by its return in the excrement of grazing animals, a source said to be appreciable (MAFF 1983). Indeed, Briggs and Courtney (1985) estimate that only 5–10% of total nutrient intake is retained in the grazing animals' bodies. In addition, *Trifolium repens*, a leguminous plant, may well fix an appreciable amount of nitrogen in the soil. Nutrients must be in solution before they are available for uptake by plants; hence soil moisture conditions are important, a factor emphasised by MAFF (1983). As has been mentioned above, the peat in Cox's Field was very dry, perhaps restricting nutrient uptake, whilst in Gibbons' Field, it was relatively moist. On the other hand, a moisture content that is too high can cause nitrogen to be leached away, a situation which could possibly have occurred in Gibbons' Field.

The nitrogen levels measured in this study are the total nitrogen content of the soil. Most of the nitrogen in the soil is in fact in the organic form, in decomposing plant protein and microbial tissues (Hesse 1971), which is unavailable to the growing plant. The amount of nitrogen that is immobilised or mineralised depends on the carbon to nitrogen ratio (C:N). As an approximation, it is thought that when the C:N ratio exceeds 30, immobilisation exceeds mineralisation, but when the ratio is 15–30, immobilisation and mineralisation are approximately equal (Foth 1978). The C:N ratios at all sites in Chapman's Field are greater than 15, the mean at 10–15 cm being 23.3 and that at 20–25 cm being 38.5 (Table 5); thus there is no net mineralisation of nitrogen taking place.

Table 5. Carbon:Nitrogen ratios

Sample Depth cm	Chapman's Field	Cox's Field	Gibbons' Field
10–15	23.3	11.5	21.3
20–25	38.5	14.8	19.0

Thus despite the high amount of total N in the soil, only a very small proportion of it is actually available to the plants. A sudden flush of nitrogen to the soil, in the form of inorganic fertilizers, will decrease the C:N ratio (Foth 1978) and allow an increase in the population of soil microbes. At first, as available nitrogen is in excess in the soil, the bacterial decomposition of organic matter may be rapid, particularly if the peat is well aerated. However, as this available nitrogen is depleted through uptake by plants and assimilation into the microbial tissues, the C:N ratio rises and organic matter decomposition will slow down.

The cultivation of a peat soil would be expected to increase the processes of organic matter decomposition set in motion by drainage. In the Fens, for example, the rate of peat wastage was found to be much higher under arable land than pasture (Hutchinson 1980). Ploughing removes the sward and exposes the peat surface to increased oxidation, aerates the peat at depth and increases its surface area. The exposure to the sun of bare peat which, being darker, has a lower albedo than grass, combined with a decrease in the peat moisture content due to drainage, would be expected to increase the temperature of the peat and accelerate soil fauna activity. Given these facts it would be expected that the organic carbon contents of both Cox's and Gibbons' Fields would be significantly lower than those of Chapman's Field. Gibbons' Field, which has been cultivated for the last ten years, would also be expected to have a significantly lower organic carbon content than Cox's Field. The results in Table 3 show, however, that at a depth of 10–15 cm the organic carbon content of only Cox's Field is significantly lower than that of Chapman's Field. There is also no significant difference between the organic carbon contents of Gibbons' and Cox's Fields. There are several possible explanations for these unexpected results. Following the drainage of peat, an increase in organic matter decomposition is to be expected due to aerobiosis. The water table in these fields is not maintained at or near the surface all the year round, so some decomposition of organic matter in the surface peat is to be expected. The peat in Cox's Field, however, as shown by the soil profile descriptions, is considerably drier than that of the other two. In Chapman's Field it is deliberate policy to maintain the water table as high as possible. In Gibbons' Field the dampness of the surface peat could be due to the failure of the under-drainage system to remove adequately the water from the field. This is quite possible as the surface of the field is considerably lower than the height of the water in surrounding drainage ditches. The low summer and high winter water table could also increase organic matter decomposition in Cox's Field by subjecting the soil to alternate wetting and drying, a factor thought to increase organic matter decomposition by allowing the soil microbe population to rejuvenate (Hesse 1971). In Gibbons' and Chapman's fields, where the amounts of available nitrogen at 10–15 cm are very similar, and the C:N ratios are high (Tables 4 and 5), organic matter decomposition is likely to be low. However, in Gibbons' Field, the high C:N ratio is likely to be confined to a short time period and will decrease when fertilizer is next applied, thus encouraging increased organic matter decomposition. In Cox's Field the C:N ratio is relatively low although a silage crop had been taken and the second fertilizer dressing had not yet been applied. Organic matter decomposition in this field is, therefore, not likely to be restricted by a deficiency in the amount of available nitrogen, perhaps at any time of year, and may only be limited by waterlogging of the peat and low winter temperature.

CONCLUSIONS

Of the soil properties studied, the organic carbon content, nitrogen content and bulk density were found to vary significantly between the three fields. There were also considerable differences between the soil profiles. Of the three fields, Cox's and Gibbons' were found to have more in common with each other than with Chapman's Field. Each of the former two fields had similar organic carbon contents, bulk densities and soil profiles. It is not possible to isolate one single cause of these differences but one recurring explanation was the height of the water table. It has been suggested that one of the causes of the lower organic carbon content at depth in Cox's and Gibbons' fields could be decomposition of the peat, accelerated by drainage and the addition of inorganic fertilizers. Similarly, peat decomposition could account for the higher bulk densities in these two fields and for the formation of a granular top soil in the soil profiles. In Chapman's Field, the effects are possibly less because the water table is maintained at a higher level and the available nitrogen content is low, thus restricting soil fauna activity. Other factors have also been implicated in increasing bulk density including grazing animals and the use of farm machinery. One unexpected result was that the organic carbon content of Gibbons' Field, which has been under cultivation for the last ten years, is not significantly lower than that of the other two uncultivated fields. However, it is possible that the original surface has been removed by wind erosion, thus exposing less decomposed peat with a higher organic carbon content. This explanation is supported by surveys that show that the land surface of Gibbons' Field has fallen following cultivation (Hancock, pers. comm.).

The results of this study suggest that the lowering of the water table may be responsible for the creation of many problems on the Somerset Peat Moors, including organic matter decomposition and land subsidence and probably the irreversible formation of a hard, dry, granular top soil.

APPENDIX 1: SOIL PROFILES

1. Catcott Heath Reserve. Land use: willow, birch, alder woodland.

Horizon (cm)	
0–9	Dark, reddish-brown (5YR 3/2) poorly decomposed peat (H4); crumb structure moist; abundant very fine fibrous roots; many woody fine roots; abrupt smooth boundary.
9–22	Dark, reddish-brown (5YR 2.5/2) little decomposed peat (H3); massive; moist; very fine fibrous roots and fine woody roots common; few medium and coarse woody roots; twigs identifiable; sharp, smooth boundary.
22–45	Dark, reddish-brown (5YR 2.5/2) practically undecomposed peat (H2); massive; wet; laminated; very fine fibrous roots common; few fine woody roots; medium woody roots common; plant remains identifiable, mainly leaves of trees, sedges, reeds; smooth boundary.
45+	Black (2.5 YR 2.5/0) practically undecomposed peat (H2); massive; very wet; laminated; few fine woody roots; tree leaves and many light-brown stems and leaves of sedges and reeds identifiable.

2. Chilton Polden Moor, Cox's Field. Land use: permanent pasture; rye grass, black grass, clover.

Horizon (cm)	
0–9	Dark, reddish-brown (5YR 3/2) fairly well decomposed peat (H6) which does not rehydrate when wet; single grain with hard, granular elements and some soft, coarse red (2.5YR 4/8) grains; very dry; abundant very fine fibrous roots; few medium woody roots; abrupt wavy boundary.
9–20	Dark, reddish-brown (5YR 3/2) fairly well decomposed peat (H6) with patches of red (2.5YR 4/8) material; single grain with many coarse red and some white (5YR 8/1) grains; dry; many very fine fibrous roots; coarse roots common and twigs identifiable; abrupt, smooth boundary.
20+	Dark, reddish-brown (5YR 2.5/2) fairly well decomposed peat (H6); massive; dry; laminated; hard; many very fine fibrous living roots; plant remains unidentifiable.

3. Catcott Moor, Gibbons' Field. Land use: short-term ley; rye grass and 'barn-sweepings'.

Horizon (cm)	
0–10	Black (10YR 2/1) somewhat to fairly well decomposed peat (H5–H6) which does not rehydrate when wet; single grain; dry; many very fine fibrous roots; few coarse woody roots and stems identifiable; abrupt, smooth boundary.
10–20	Black (10YR 2/1) poorly to little decomposed peat (H3–H4), some remaining hard and granular when wet; single grain and massive; moist; very fine fibrous roots common; some coarse woody roots and stems identifiable; abrupt, smooth boundary.
20+	Black (10YR 2/1) practically undecomposed peat (H2); massive; wet; abundant very fine roots; many leaves, and coarse and medium woody roots identifiable.

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