

SHETLAND VEGETATION SURVEY

HANDBOOK OF FIELD METHODS

Merlewood, May 1974.

VEGETATION SURVEY OF SHETLAND

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Preface

The purpose of this handbook is to fill you in on the background to this summer's survey, to explain its purpose, and to give a detailed account of the methods involved in the vegetation survey.

Introduction

The Shetland Islands cover an area of about 550 square miles, and consist of well over a hundred islands and islets, of which about fifteen are inhabited. The southernmost tip of Mainland, the largest island, lies over 100 miles north-west of John-O' Groats.

Geologically, the islands are very diverse. The main rock types are metamorphic, deriving from the Caledonian mountain-building period some 450 million years ago: those include schists, gneisses, quartzites and limestones. There are extensive deposits of Old Red Sandstone, mainly in the west, the extreme south, and the east of Mainland; and there are igneous rocks of both Caledonian and Old Red Sandstone age. These are mainly granites and diorites, with serpentine in the extreme north on Unst and volcanic lavas among the sandstone.

The inland topography is gentle, with wide valleys, on the limestone especially, and hills extending up to 1475' (on Ronas Hill in North Mainland) but mostly c. 800 ft. Around the shores, there is a striking contrast between the sheer cliffs on many of the exposed coasts, and the numerous "voes" or inlets, which are very sheltered and calm.

These were formed by the drowning of river valleys when the sea-level rose after the ice-ages.

Very few trees grow on Shetland, and nearly all of those are planted, in the more sheltered parts. Extensive areas are covered by peat, especially on Mainland and the large northern island of Yell. As a result, much of Shetland has a very monotonous appearance.

The population of Shetland is about 18,000, and the main traditional industries are fishing, crofting and knitting. Fishing, particularly the whitefish industry, can be very profitable, especially for some of the smaller inhabited islands.

The soil on Shetland is poor in most parts, and only about 6% of the land area is under cultivation. The best soils lie on the sandstone in the south, and on the limestone areas; these are the main crofting districts. Most agricultural land is under grass.

The Shetland climate is best summed up as being mild, moist and windy. Due to the proximity of the sea to all parts of the islands, there is little variation in temperature through the year, average monthly temperatures ranging from 3°C (Feb.) to 12°C (July-August). The exposed situations of the islands means that they are subject to high winds, with about 40 days of gales per year. The rainfall, however, is not extreme (about 40" per annum), but it is distributed throughout the year, so that damp, misty and drizzly days are very common.

Background to the survey

The discovery of extensive oil fields off the east coast of Shetland, and the likelihood of more being found to the west, has meant that Shetland has to face the prospect of large-scale development. Initially, this has meant the provision of service facilities for off-shore rigs, but within the next few years when the oil is landed, the oil companies will be needing pipelines, oil terminals, greatly increased servicing facilities, and new housing for the oil workmen.

Such development is bound to conflict with the traditional way of life of the islands, and this prospect has been of great concern to the County Council, who are preparing a Development Plan to form the basis of future planning.

One of the potentially serious threats to the islands is the effect that development will have on the natural features of the Shetland: the geology, the landscape and the wildlife.

At the moment, information on Shetland wildlife is generally diffuse and scattered, and there are large gaps in our knowledge. To remedy this situation, the Institute of Terrestrial Ecology, (which was formerly the Research branch of the Nature Conservancy) is organising a survey to cover as many aspects as possible of the natural environment of Shetland.

This summer, work will be done particularly on the terrestrial vegetation, the freshwater and littoral habitats, and the sea-bird populations. A survey of the geomorphology and geology of Shetland, based on information derived from maps, has already been completed, and later stages of the work will involve development of mathematical models to try to predict the effects of specified factors on the Shetland environment in its present state.

The vegetation survey

The survey of the terrestrial vegetation of Shetland, in which you will be involved this summer, is based on methods developed here at Merlewood, by Bunce and Shaw (1973), for surveys of the semi-natural woodlands of Great Britain and also used in a survey of the native pinewoods of Scotland.

A number of randomly - distributed points are marked on a map, and these are taken as the sampling plots for the survey. Each plot, is visited, and a 200.m² quadrat is set up. Within this quadrat, all the plants are recorded, a soil pit is dug and described, and information is recorded on the habitats present, using a system similar to that advocated by Elton and Miller (J. Ecol. 42, 460). After the summer, this data will be analysed, using multivariate techniques, such as ordination, to help establish the range of variation in Shetland vegetation. It will also be used to help set up the mathematical models of the environment.

Methods (i) locating the plot

You will be working in pairs on the survey, and the work can be split between you; you will soon develop your own method of working as a team.

The first step will always be to locate the sampling plot you are going to visit. These plots are marked as numbered points on the 1" O.S. maps which you will have been given. Alternatively, they may be marked on aerial photographs: see next section.

You should first get to the general area where the plot is located. First thing in the morning, you will either be driven out from one of the bases and dropped near your first plot, or, if you are on a trip away from a base for several days (as will happen when working on some of the islands and remoter areas of Mainland - in this case camping equipment will be provided) you will have to walk out from your camp. Later in the day, you will usually be walking from the previously-completed plot.

Since the plots are distributed in a random manner, it is important that there should be no subjective bias in locating them on the ground, and the plots in the field should be located as accurately as possible from the map. This is done in stages.

i) Firstly, find an easily-recognisable landscape feature on the map, near the plot to be sampled, which can be readily located in the field; such a feature could be a sharp bend in a road or track, a fork in a river, the corner of a lake, or any other such unambiguous feature.

ii) Go to this control point on the ground.

iii) Using the map and Silva compass provided, take a bearing from the control point to the plot to be visited. Don't forget to add 10° for magnetic declination.

iv) Measure the distance from the control point to the plot, using the scale on the Silva compass. This is in $1/16$ ths of an inch; $1/16$ of an inch on the map will equal 110 yards on the ground.

v) Now pace the exact number of yards measured from the control point, following the correct bearing on the compass. The last pace you take will land your foot exactly in the middle of the plot to be sampled.

You should make allowance if your pace is less than one yard on average (i.e. if your average pace is 2'6", add on 6" for each pace, or in other words, one extra pace every five).

If you need to pace uphill, you will have to add on extra paces to compensate for this. Thus for slopes of the approximate angle given below, add the given percentages onto the original number of paces.

20°	25°	30°	35°	40°
6%	10%	15%	22%	31%

For example, if the distance from your control point to the plot is $1/16$ " on the map, (i.e. 110 yards on the ground), and it is all up a slope of about 25° , you should add on 11 yards, making 121 paces in all.

If this procedure is rigidly adhered to, it will ensure absolute absence of bias in locating the sampling plot. There may be some loss of accuracy (for example due to a slight deviation from the bearing walked, or the paces being slightly longer or shorter than 1 yard), so that the point on the map and the point in the field do not correspond exactly. This however, is not important, as long as there has been no subjective bias in locating the plot in the field.

On a few occasions, a plot on the map will not in fact be surveyed. This will mainly be the case if there is any risk to life; for example, if the plot turns out to be on a steep cliff on a dangerously boggy piece of ground. Plots should also be scrubbed if they turn out to be on cultivated land, such as cabbage patches or potato fields. If a plot is on grassland which is obviously used for grazing and is enclosed, permission should be asked of the crofter concerned before venturing on it.

If we are able to obtain aerial photographs of Shetland at a 1:10,000 scale before the field season, however we will use those to locate the plots. You will be provided with aerial photographs of the area around the plot, with the plot centre marked on as a point or pin-hole. You will then simply have to locate the area of the photo, using the map, and then navigate your way to the plot, using features identifiable on the ground from the photos. To give you an idea of the scale of those photos, a distance of 1 mm on the photo represents 10 metres (about 10 paces) on the ground.

We have included descriptions of both methods of locating plots, since we have not, as yet, decided which will be used; i.e. maps or photographs.

Recording data in the plot

The basic sampling unit, as mentioned above, is a 200 m^2 quadrat. This is set up using the five posts and strings provided. The centre post has a bolt on top, on which is a right-angled cross held on by a wing-nut. The other four posts are the corner-poles of the plot, and each has a 10-metre cord tied to it. Each of these cords can be attached to the centre pole by clips, and they form the diagonals of the plot.

When a quadrat is set up, the centre post should be stuck into the ground at the central point of the plot (which has been paced out as described above). The cross on top of the post should be spun round, and when it has stopped, it should be secured in position by tightening the wing-nut. This cross is used to orientate the four diagonals, and spinning it ensures that this orientation is random.

The next stage is to unroll the orange cord from each of the corner posts, and to clip it onto the centre post. The corner post should be carried out by one member of the team until the cord is taut; the other member can use the nails in the right-angled cross to sight onto the corner post, to make sure that it is orientated correctly.

When the cords are stretched out, it will be seen that they have four pieces of coloured rope tied on them at specified distances from the centre. These mark the corners of successively smaller quadrats within, and concentric with, the large 200 m^2 quadrat. Thus there are five quadrats in all, of respectively 4 m^2 , 25 m^2 , 50 m^2 , 100 m^2 and 200 m^2 . This is illustrated in figure 1. These five quadrats are the sampling units for the vegetation.

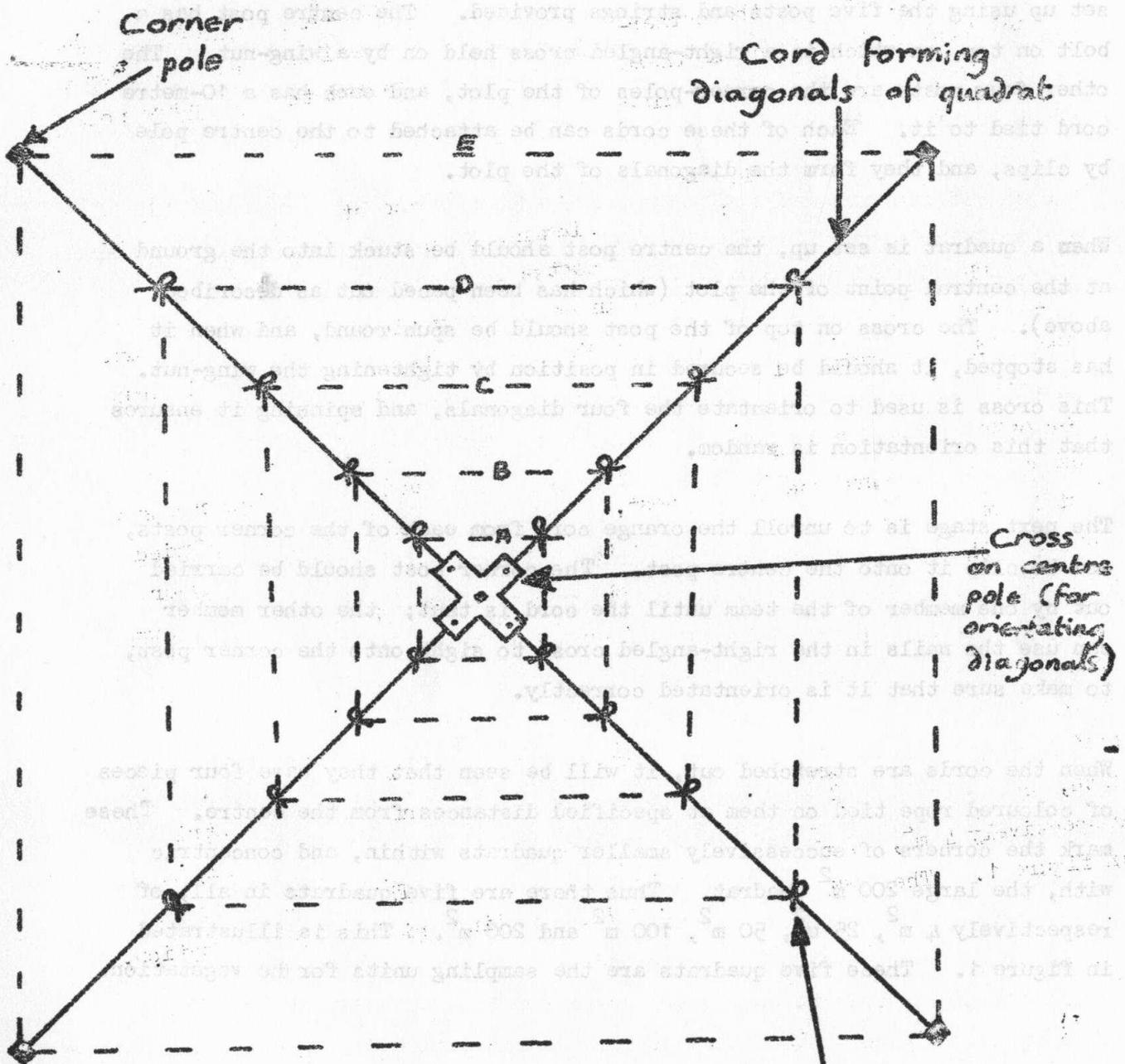
Coloured rope knots marking the corners of smaller quadrats

Key:	A - outside of 4m ² quadrat	B - 25m ²	C - 50m ²	D - 100m ²	E - 200m ²

Figure 1

Aerial view of quadrat

(To scale: 1cm = 1m)



- Key: A = outside of 4m² quadrat
B = " " 25m² "
C = " " 50m² "
D = " " 100m² "
E = " " 200m² "

Coloured rope + knots,
marking the corners of
smaller quadrats.

Ground flora

The sheet used for recording the ground flora is shown in figure 2. When filling it in, first enter the stratum and plot numbers as given on the map. (Thus point no. 12: 7 on the map is recorded as Stratum no. 12. Plot no. 7).

You should start recording in the smallest quadrat, (the 4 m^2 quadrat). All vascular plants, bryophytes and macrolichens growing on the soil in this quadrat should be recorded in the space on the data sheet marked " 4 m^2 quadrat". Any plants which are not known, or whose identification is dubious, should be put in a polythene bag, clearly labelled with the plot number, and retained for identification or confirmation. Mosses and lichens not growing on the soil (e.g. those epiphytic on heather, or growing on rock) are to be ignored.

Next, move out into the 25 m^2 quadrat, and repeat this procedure, this time only recording plants which have not occurred in the 4 m^2 quadrat; then carry on out into each of the three remaining quadrats, each time only recording plants which have not been found in inner quadrats.

When the presence of all the plants has been recorded, the next thing is to work out a percentage cover-abundance for each species for the full plot. Estimates should be given to the nearest 5%. If a species is widely scattered, but with less than 5% cover, it should be recorded as 1 in the cover-abundance column. Species occurring as only a singly or a few isolated specimens should be recorded as +. It is advisable for both members of the team to estimate % cover for each species, at least at first and to record the mean value of the two estimates, in order to increase its reliability.

The cover-abundance % of the other categories (rock, water, litter, bare ground and bryophytes) should be recorded at the bottom of the sheet.

Code	Species (4 m ² quadrat)	C.A. %	Code	Species (50 m ² quadrat)	C.A. %
	<i>Calluna vulgaris</i>	65		<i>Cladonia impeia</i>	+
	<i>Sphagnum rubellum</i>	5		<i>Luzula multiflora</i>	+
	<i>S. papillosum</i>	1			
	<i>S. plumulosum</i>	1			
	<i>Eriophorum vaginatum</i>	5			
	<i>Eriophorum angustifolium</i>	5			
	<i>Odontoschisma sphagni</i>	+			
	<i>Erica tetralix</i>	1			
	<i>Thuidium bamariscinum</i>	+			
	<i>Rhytidiadelphus loreus</i>	+			
	<i>Pleurozium schreberi</i>	+			
	<i>Hypnum cupressiforme</i>	+			
Code	Species (25 m ² quadrat)	C.A. %	Code	Species (100 m ² quadrat)	C.A. %
	<i>Dicranum scoparium</i>	1		<i>Cladonia pyxidata</i>	+
	<i>Erica cinerea</i>	1			
	<i>Hylocomium splendens</i>	+			
	<i>Scoparia gracilis</i>	+			
Code	Species (200 m ² quadrat)	C.A. %			
	<i>Potentilla erecta</i>	+			
	<i>Aulacomnium palustre</i>	+			
	<i>Sphagnum cuspidatum</i>	+			

Cover/abundance of other categories } Rock =
 } Bare ground =
 } Water =
 } Bryophytes = 15%
 } Litter =
 } 1%

Code	Species (4 m ² quadrat)	C.A. %	Code	Species (50 m ² quadrat)
	<i>Calluna vulgaris</i>	40		<i>Rhytidiadelphus squarrosus</i>
	<i>Antennaria dioica</i>	1		
	<i>Carex flacca</i>	10		
	<i>Dicranum scoparium</i>	1		
	<i>Phacomitrium lanuginosum</i>	1		
	<i>Thymus drucei</i>	1		
	<i>Mercurialis pilosella</i>	5		
	<i>Prunella vulgaris</i>	1		
	<i>Deschampsia flexuosa</i>	15		
	<i>Plantago lanceolata</i>	1		
	<i>Potentilla erecta</i>	1		
	<i>Cladonia impexa</i>	1		
	<i>Succisa pratensis</i>	+	Code	Species (100 m ² quadrat)
	<i>Tortella tortuosa</i>	+		<i>Hylocomium splendens</i>
	<i>Pseudoscleropodium purum</i>	+		<i>Weissia controversa</i>
	<i>Breutelia chrysocoma</i>	+		
	<i>Hypericum pulchrum</i>	1		
	<i>Hypericum cupressiforme</i>	1		
	<i>Agrostis canina</i>	5		
	<i>Festuca ovina</i>	5		

Code	Species (25 m ² quadrat)	C.A. %
	<i>Carex binervis</i>	1
	<i>Lycopodium selago</i>	+
	<i>Funaria obtusa</i>	+
	<i>Viola riviniana</i>	1
	<i>Polytrichum formosum</i>	1

Code	Species (200 m ² quadrat)
	<i>Cladonia pyxidata</i>

Cover/abundance of } Rock = 1% Water = 10% Litter =
 other categories } Bare ground = + % Bryophytes =

Ignore the column marked "code". This is for use later on when sorting out the data back at Merlewood. Examples of completed field sheets are given in Figure 2.

Soil

To obtain a general picture of the type of soil present in the plot, without letting soil sampling become a time-consuming exercise, the soil is to be described from a single profile, in the exact centre of the plot (i.e. where the centre pole was placed). The soil data sheet has been worked out in advance (see Figure 3), and all that you have to do is to cross off those attributes which apply to the profile in question. To expose a profile, dig down as deep as you can with the spade, and collect cores of the soil below this level using the auger.

First, it is necessary to distinguish between the different horizons of the soil. The litter layer consists of undecomposed or readily recognisable plant remains. If this is present, record the depths between which it is found (attribute 5) and its composition; this is done by seeing what plant remains you can recognise in the litter (attributes 6 - 13). If there is standing water in the soil saturating the litter layer, record attribute 14. If there is no litter layer, delete this section completely with a diagonal line.

The organic matter layer consists of decomposed plant remains, with no (or virtually no) admixed mineral matter. This may be very shallow, as on some grassland, or very deep, where there is deep peat cover. If this is present, record the depths between which it occurs. If the peat is deeper than the length of the auger, record the maximum depth as 75+ cm (75 cm. is the length of the auger).

Colour (attributes 16-18): self explanatory.

Decomposition: this is a measure of the amount of decay of the organic matter. To determine this, take a handful of the organic matter and squeeze it in your hand. If only clear water oozes out, record low decomposition (21). If the whole handful oozes out as a black mush, then the material is completely decomposed (attrib. 19). If blackish or brownish water emerges, record medium decomposition (20).

Texture: Amorphous (22) humus rubbed in the fingers will break up into a black smear; if granular (23), it will retain some crumb-like structure when rubbed. Mixed fibrous-amorphous (25) is an intimate mixture of the two types of organic matter; layered f - a. (26) indicates the two types are separate, and distinctly layered.

Moisture: it will be obvious if the soil is submerged (27). If a handful of organic matter oozes water without being squeezed it is very wet (28); if it has to be squeezed to expel water, it is wet (29). If no water oozes out on being squeezed, it is damp (30), and if it feels dry, record 31.

If there is no organic matter layer, delete this section.

The mixed mineral/organic matter layer is an intimate mixture of mineral particles and humus. This layer will often be only poorly developed. It can be distinguished from overlying organic matter by rubbing in the fingers, when mineral particles will be felt, and from underlying mineral matter by the dark colour of the admixed humus. If present, record the depths between which it is found: if it extends below the depth of the auger, again record maximum depth as 75+ cm.

Transition with mineral soil: the transition to the underlying mineral soil (if present) can be abrupt (33) or the two layers will gradually blend, with no distinct join between them (34). If there is no underlying mineral soil reached, cross out this section.

Texture: to distinguish clay (35), silt (36), and sand (37), try to roll a lump of soil between your hands into a sausage. If you cannot succeed, and the roll crumbles, it is sand. If you can, and can then bend this sausage into the form of a ring, it is clay. If the sausage breaks when you try to bend it, it is silt. If the layer consists of pure gravel (particles over 1/8"), record 38. If more than about 10% of this layer is made up of stones, record attributes 39-41, depending on the texture of the matrix (determined by the sausage test).

Colour: fairly obvious. A mottled layer (46) is one where changes in the water level cause alternating aerobic and anaerobic conditions, which will lead to deposition of iron oxides in the mineral matter. The mottled appearance is revealed by breaking the soil up in your fingers, when you will see alternating pale and reddish patches. This occurs most commonly in clays.

Moisture: as for the organic layer.

Structure: this is the type of aggregation shown by the soil particles, and is determined by breaking the soil in your fingers. If there is no aggregation at all between particles, it is a powder (51). If the particles aggregate in to small lumps (like breadcrumbs) it is a crumb (52) and if it stays as a solid lump, it is a clod (53). (This latter is most typical of clay soils).

Again, if this layer is not present, delete this section.

The leached layer is a pale layer immediately underlying the organic matter layer, and occurs typically in high rainfall areas, where humus and mineral ions are washed down through the soil, to form a podzol. It will usually be underlain by the weathered mineral layer. If present, record the depth, the colour (white - 55 - or grey - 56), and the texture (determined in the same way as for the mixed mineral/organic layer. If absent, delete this section.

SOIL DATA

1 Stratum no. (Bog) 2 Plot no 1

3 Recorder RB+PAB 4 Date 4/3/74

LITTER LAYER

5 Depth 0 - 3 cm
~~6 Sphagnum~~
~~7 Other bryes~~
 8 Fern

Composition:
~~9 Ericoid~~ 12 Grass/sedge
 10 Other dicots 13 Other monocots
~~11 Brioph/Trichoph~~ 14 Standing water

ORGANIC MATTER LAYER

15 Depth 3-75+ cm Decomposition:
 Colour: ~~19 High~~
 16 Black 20 Medium
~~17 Dark brown~~ 21 Low
 18 Light brown

Texture: Moisture:
 22 Amorphous 27 Submerged
 23 Granular ~~28 V. wet~~
 24 Fibrous 29 Wet
~~25 Mixed fib/amorph~~ 30 Damp
 26 Layered fib/amor 31 Dry

MIXED MINERAL/ORGANIC MATTER LAYER

32 Depth - cm Texture:
 35 Clay
 36 Silt
 Transition with 37 Sand
 mineral soil: 38 Gravel
 33 Sharp 39 Stony/clay
 34 Gradual 40 Stony/silt
 41 Stony/sand

Colour: Moisture:
 42 Black 47 V. wet
 43 Brown 48 Wet
 44 Yellow/brown 49 Damp
 45 Red 50 Dry
 46 Mottled Structure:
 51 Powder
 52 Crumb
 53 Clod

LEACHED LAYER

54 Depth - cm Colour:
 55 Whitish
 56 Greyish

Texture: Moisture:
 60 Gravel
 57 Clay 61 Stony/clay
 58 Silt 62 Stony/silt
 59 Sand 63 Stony/sand

WEATHERED MINERAL LAYER

64 Depth - cm Texture:
 69 Clay
 70 Silt
 Moisture: 71 Sand
 65 V. wet 72 Gravel
 66 Wet 73 Stony/clay
 67 Damp 74 Stony/silt
 68 Dry 75 Stony/sand

Colour: Natur. of
 76 Brown deposition layer
 77 Yellow/brown (if present)
 78 Yellow
 79 Red Colour:
 80 Mottled 84 Black
 Structure: 85 Red/brown
 81 Powder Compaction:
 82 Crumb 86 Hard
 83 Clod 87 Friable

UNDERLYING MATERIAL

88 Depth from cm Texture:
 89 Clay

90 Sand 93 Stony/sand
 91 Gravel 94 Rock fragments
 92 Stony/clay 95 Solid rock

1 Stratum no (Serpentin) Plot no 2

3 Recorder RB + PAB 4 Date 5/3/74

LITTER LAYER

5 Depth 0 - 1 cm
6 Sphagnum
~~7 Other bryes~~
8 Fern

Composition:

~~9 Ericoid~~ 12 Grass/sedge
~~10 Other diots~~ 13 Other monocots
11 Erioph/Trichoph 14 Standing water

ORGANIC MATTER LAYER

15 Depth - cm
Colour:
16 Black
17 Dark brown
18 Light brown

Decomposition:
19 High
20 Medium
21 Low

Texture:

~~22 Amorphous~~
23 Granular
24 Fibrous
25 Mixed fib/amorph
26 Layered fib/amor

Moisture:

27 Submerged
28 V. wet
29 Wet
30 Damp
31 Dry

MIXED MINERAL/ORGANIC MATTER LAYER

32 Depth 1 - 12 cm
Transition with
mineral soil:
33 Sharp
34 Gradual

Texture:
35 Clay
~~36 Silt~~
37 Sand
38 Gravel
39 Stony/clay
40 Stony/silt
41 Stony/sand

Colour:

42 Black
~~43 Brown~~
44 Yellow/brown
45 Red
46 Mottled

Moisture:

47 V. wet
48 Wet
~~49 Damp~~
50 Dry
Structure:
51 Powder
~~52 Crumb~~
53 Clod

LEACHED LAYER

54 Depth - cm
Colour:
55 Whitish
56 Greyish

Texture:
57 Clay
58 Silt
59 Sand

Texture:

60 Gravel
61 Stony/clay
62 Stony/silt
63 Stony/sand

Moisture:

60 Gravel
61 Stony/clay
62 Stony/silt
63 Stony/sand

WEATHERED MINERAL LAYER

64 Depth - cm
Texture:
69 Clay
70 Silt
71 Sand
72 Gravel
73 Stony/clay
74 Stony/silt
75 Stony/sand

Moisture:
65 V. wet
66 Wet
67 Damp
68 Dry

Colour:

76 Brown
77 Yellow/brown
78 Yellow
79 Red
80 Mottled
Structure:
81 Powder
82 Crumb
83 Clod

Nature of
deposition layer
(if present)

Colour:
84 Black
85 Red/brown
Compaction:
86 Hard
87 Friable

UNDERLYING MATERIAL

88 Depth from 1/2 cm
Texture:
89 Clay

90 Sand
91 Gravel
92 Stony/clay

90 Sand
91 Gravel
92 Stony/clay

93 Stony/sand
94 Rock fragments
~~95 Solid rock~~

Habitat data

These two sheets are intended to record various features of the area, some being physical variables and attributes, while others can also be considered in terms of their value as microhabitats for, say, invertebrate life. Yet others record the present management régime of the area.

The first sheet (plot habitat data) is to record those features found within the plot. The second sheet (habitats within 50 m. of plot edge) is to record features lying outside the plot, up to a distance of 50 m, which may have an effect on the plot itself. When you start work, it is advisable to pace out 50 m, but soon you should get a rough idea of the distance simply by looking. (50 m. is in fact $2\frac{1}{2}$ times the length of the diagonal of the 200 m² quadrat.)

Plot habitats

Record stratum and plot number, as for the other sheets. The slope (attribute 5) is measured, using the clinometer provided, across the plot from the highest to the lowest point, passing through the centre. If one member of the team stands at the highest point, the other can go to the lowest point, and sight along the wooden body of the clinometer. When the plumb line has steadied, hold it in place against the protractor scale and read off the slope. Aspect (6) is the bearing down this same slope, measured with the silva compass. (Do not read the aspect up the slope).

Rocky habitats: 7-9 must be solid outcrops, and not loose boulders (as far as can be determined). A rock ledge (10) is a horizontal surface of any size on a rock outcrop or cliff. A gully (11) is the space between two rock outcrops facing one another. It should be at least 3 m. high, and under $1\frac{1}{2}$ times its height across from face to face. Stones, rocks and boulders (12-14) are loose rocks lying on the ground, distinguished by size. Rock piles (15) must be at least 1 m high, and can be artificial

or natural. Rock patterns (16) are regular patterns made by rocks, due to such features as creep, wind and/or frost. They usually take the form of alternate stripes of rock and turf. Stone, rock and boulder fields (17-19) are areas where at least 50% of the ground area is covered in loose rocks: the distinction between the three is based on the mean size of the rocks (as in 12-14). A scree (20) is fairly obvious: it must be at least 20 m^2 , and be unstable. This also includes man-made screes caused by earth-moving operations. Eroded mineral soil and eroded peat (21 & 22) are also obvious: they must be at least 1 m^2 to be recorded.

Vegetation habitats: dense heather (23) must be at least 25 m^2 to be recorded. Grassland (26) is an area of at least 100 m^2 where the dominant plants are grass. Sphagnum tussocks (25) must be at least 1 m across. A Sphagnum lawn (26) is an area of Sphagnum covering at least 10 m^2 . Moss tussocks (27) must be at least 1 m across, and be terminated by any bryophyte other than Sphagnum. Fern clumps (28) can be of any form, including bracken: they must cover at least 2 m^2 to be recorded. Spring bryophytes (29) are any bryophytes growing around the area of a spring. Attributes 30-32 cover the presence of any bryophyte growing on soil, rock or peat. Aquatic bryophytes (33) are those growing in running or still water. All lichens on soil, peat or rock should be recorded (34-36): the small crustose lichens on rock may be hard to see at first, but are obvious when looked for. Epiphytic lichens (37) are those growing on other plants; i.e. trees, shrubs, Calluna, bryophytes, etc. Aquatic vegetation (38) covers only true aquatic plants; not land plants which have been submerged. Any macrofungi seen should be noted (39), and also any live tree or shrub which may be growing in the plot (40).

Aquatic habitats: fresh-water bodies are distinguished as three size classes (41-43). Slow and fast streams (44 and 45) are distinguished as those flowing slower or faster than 1 mph - i.e. a slow walking speed. If a stream is present in the plot, then the nature of its bed should be recorded (46-50): there may, of course, be more than one type in a plot. If there is a definite spring emerging from the ground it should be recorded as 51 or 52. If, however, there is only a slight ooze of water, without it forming a definite spring, record it as a seepage (57). Any artificial ditch or drain should be noted as wet (54) or dry (53). A marsh or bog (55) is any area which oozes water under your foot when you tread on it. Water trickles are small, continuous streams of water which do not follow any well-defined watercourse (e.g. which just trickle over the surface of a bog). If a peat-cutting has become flooded to a depth of at least 6", record it as drowned (58). A river bank (59) is any slope over 1 m high going down to a river. A river cutting (60) is a cutting through rock, at least 1 m deep.

Animals: sheep, cattle, pony and rabbit (61-64) may be recorded either if seen in the plot while approaching it, or if traces are found (e.g. droppings, hoof-marks, wool, etc.) If there is any sign of the vegetation having been eaten (e.g. grass leaves chopped off short), record it as bitten (65). If there are droppings of any sort present, at average density of about $5/m^2$ or less, record few (66); if more than about $5/m^2$, record many (67). A sheep lay (68) is an area where sheep lie overnight: it may show some flattening of the vegetation, but is typical chiefly by the piles of droppings which are clustered around.

If there has obviously been no grazing at all in the plot (e.g. if it is fenced off, with lush vegetation) record this (69). If any dead bodies or bones of animals are found, this should be noted (70). The presence of earthworms (71) will be noted when the soil profile is being done.

Management: most of these categories are fairly self-explanatory. Any wall in the plot should be recorded (72 & 73); only man-made embankments are to be recorded (74). Be sure to distinguish peat diggings (75) from naturally eroding peat (22). A fence (76) covers all sorts: post and rail, wire-netting, barbed wire, etc. Drain lines (77) indicates any sign that artificial drainage of the area has been carried out. Distinguish sheep enclosures in use (78) from ruined ones (79); the same with buildings (80 & 81). Domestic rubbish (82) covers anything of household origin, beer cans, etc. Other rubbish (83) is anything else (e.g. fertiliser bags, scrapped machinery, etc). Paths and tracks (84 and 85) are not made up; handcart tracks (86) are made up but not tarmacked. "Metalled road" (87) is a misprint; it should read "tarmac road;" thus only roads which have been tarred over should be recorded here. A midden (88) is a manure heap; obvious if recent, but old ones are easily recognised as piles of rocks with dense nettles growing out of them.

If obvious traces of burning are present among the vegetation (e.g. ashes, charred heather), record this as recent burning (89). If there are no signs of burning evident among the vegetation, but traces are found in the topsoil or among the surface litter (e.g. fragments of charcoal), record past burning (90). Any form of quarrying or excavation, other than past diggings, is recorded as 91.

On the space at the bottom of the form record any other useful information you can think of concerning the area within the plot. If you can recognise rocks, it would be useful to record geological information from the plot (e.g. the nature of the solid geology from outcrops, the nature of the surface boulders, if any, what rocks were found in the soil, and what the drift geology is). Anything unusual not covered by the other sheets can be put down; any small animals you may recognise, or anything else that comes to mind.

ROCKY HABITATS

- | | | | |
|------------------|--------------------|------------------|------------------------|
| 7 Outcrop (<1m) | 11 Gully | 15 Rock pile | 19 Boulder field |
| 8 Outcrop (1-5m) | 12 Stone (<5cm) | 16 Rock patterns | 20 Scree |
| 9 Outcrop (>5m) | 13 Rock (5-50 cm) | 17 Stone field | 21 Eroded mineral soil |
| 10 Rock ledge | 14 Boulder (>50cm) | 18 Rock field | 22 Eroded peat |

VEGETATION HABITATS

- | | | | |
|---------------------------------|-----------------------------|-------------------------------|---------------------|
| 23 Dense heather | 28 Fern clumps | 33 Aquatic bryos | 37 Epiphytic licher |
| 24 Grassland | 29 Spring bryos | 34 Lichens on soil | 38 Aquatic vegetn |
| 25 Sphagnum tussocks | 30 Bryos on soil | 35 Lichens on peat | 39 Macrofungi |
| 26 Sphagnum lawn | 31 Bryos. on rock | 36 Lichens on rock | 40 Tree/shrub |
| 27 Moss tussocks | 32 Bryos on peat | | |

AQUATIC HABITATS

- | | | | |
|-------------------------------|------------------|-------------------------|------------------------------|
| 41 Pool (<1m ²) | 46 Muddy bottom | 51 Rocky spring | 56 Water trickles |
| 42 Pond (1-20m ²) | 47 Peat bottom | 52 Peat spring | 57 Seepage |
| 43 Lake (>20 m ²) | 48 Sandy bottom | 53 Dry ditch | 58 Drowned peat cuts |
| 44 Slow rivr/strm | 49 Gravel bottom | 54 Wet ditch | 59 River bank |
| 45 Fast rivr/strm | 50 Rocky bottom | 55 Marsh/bog | 60 River cutting |

ANIMALS

- | | | | |
|---------------------|---------------------------------|------------------------------|-----------------|
| 61 Sheep | 64 Rabbit | 67 Many droppings | 70 Corpse/bones |
| 62 Cattle | 65 Vegetation bitten | 68 Sheep lay | 71 Earthworms |
| 63 Pony | 66 Few droppings | 69 No grazing | |

MANAGEMENT

- | | | | |
|----------------|--------------------|--------------------------------|-------------------|
| 72 Wall | 77 Drain lines | 82 Domestic rubbish | 87 Metalled road |
| 73 Ruined wall | 78 Sheep enc. | 83 Other rubbish | 88 Midden |
| 74 Embankment | 79 Ruined enc. | 84 Path (<1 m) | 89 Recent burning |
| 75 Peat dig | 80 Building in use | 85 Track (1-5m) | 90 Past burning |
| 76 Fence | 81 Ruined buldgo | 86 Hardcore track | 91 Quarry/excvtn |

GEOLOGICAL INFORMATION AND ANY OTHER COMMENTS

Blanket bog on deep peat: very wet. No rock outcrops or stones in plot. Very heavily grazed.

(Serpentine): Plot no. 2
5 Slope 12 " 6 Aspect 324°

3 Recorder RB+PAR 4 Date 5/12

ROCKY HABITATS

- | | | | |
|-------------------------------|-------------------------------|------------------|------------------------|
| 7 Outcrop (<1m) | 11 Gully | 15 Rock pile | 19 Boulder field |
| 8 Outcrop (1-5m) | 12 Stone (<5cm) | 16 Rock patterns | 20 Scree |
| 9 Outcrop (>5m) | 13 Rock (5-50cm) | 17 Stone field | 21 Eroded mineral soil |
| 10 Rock ledge | 14 Boulder (>50cm) | 18 Rock field | 22 Eroded peat |

VEGETATION HABITATS

- | | | | |
|-------------------|-----------------------------|-------------------------------|---------------------|
| 23 Dense heather | 28 Fern clumps | 33 Aquatic bryos | 37 Epiphytic licher |
| 24 Grassland | 29 Spring bryos | 34 Lichens on soil | 38 Aquatic vegetn |
| 25 Sphagnum tssks | 30 Bryos on soil | 35 Lichens on peat | 39 Macrofungi |
| 26 Sphagnum lawn | 31 Bryos on rock | 36 Lichens on rock | 40 Tree/shrub |
| 27 Moss tussocks | 32 Bryos. on peat | | |

AQUATIC HABITATS

- | | | | |
|-------------------------------|------------------|-----------------|----------------------|
| 41 Pool (<1m ²) | 46 Muddy bottom | 51 Rocky spring | 56 Water trickles |
| 42 Pond (1-20m ²) | 47 Peat bottom | 52 Peat spring | 57 Seepage |
| 43 Lake (>20 m ²) | 48 Sandy bottom | 53 Dry ditch | 58 Drowned peat cuts |
| 44 Slow rivr/strm | 49 Gravel bottom | 54 Wet ditch | 59 River bank |
| 45 Fast rivr/strm | 50 Rocky bottom | 55 Marsh/bog | 60 River cutting |

ANIMALS

- | | | | |
|---------------------|---------------------------------|-------------------|----------------------------|
| 61 Sheep | 64 Rabbit | 67 Many droppings | 70 Corpse/bones |
| 62 Cattle | 65 Vegetation bitten | 68 Sheep lay | 71 Earthworms |
| 63 Pony | 66 Few droppings | 69 No grazing | |

MANAGEMENT

- | | | | |
|----------------|---------------------------|---------------------|-------------------|
| 72 Wall | 77 Drain lines | 82 Domestic rubbish | 87 Metalled road |
| 73 Ruined wall | 78 Sheep enc. | 83 Other rubbish | 88 Midden |
| 74 Embankment | 79 Ruined enc. | 84 Path (<1 m) | 89 Recent burning |
| 75 Peat dig | 80 Building in use | 85 Track (1-5m) | 90 Past burning |
| 76 Fence | 81 Ruined buldg | 86 Hardcore track | 91 Quarry/excvtn |

GEOLOGICAL INFORMATION AND ANY OTHER COMMENTS

Shallow soil over serpentine; several serpentine outcrops in plot.
Vegetation v. short; heavy grazing pressure. Many loose rocks
among vegetation.

Examples of completed plot habitat sheets are shown in figure 4.

50 m area habitats

This is similar in many respects to the plot habitat sheet. The instructions for the aquatic habitats and the animals are identical to the plot sheet, as are those for the management category, with a few additions. Attribute 41 records any sign of ploughing in the current year. The types of buildings are differentiated. A croft (43) is the typical crofting cottage, still in use as a croft. If the croft is ruined, record 44. A house (45 - 47) is any dwelling place not forming part of a crofting farm. Any other buildings (e.g. barns) are recorded (48 if in use: 49 if ruined). Peat stacks (62) are the piles of peat turfs stacked to dry near the diggings, or by a road.

Land use and landforms: mostly fairly obvious. Areas of rough grazing (63) are those where no improvement has obviously taken place: e.g. areas of moor and bog where sheep are simply put out. This contrasts with improved grazing (64), when the land has been drained and/or fertilised. Arable land (65) is that used for growing crops. Any other human activity (66) covers anything that is not agricultural (e.g. a village, a garage, a small factory, etc). Some plots may lie near the sea, when maritime landforms will be noted (67-70). Wet bog differs from blanket peat in that water lies at or very near the surface: on blanket peat, the ground is firm, and oozes little, if any, water when trodden on. Areas of bog, peat, grassland, saltmarsh or dunes (71-75) must be over 100 m² in extent to be recorded. River gorges must be at least 3 m deep.

The space at the bottom can be again used to fill in any other information which may occur to you while doing the plot; for example, the solid and drift geology, the birds in the area, any insects you may recognise, what the weather is like, or anything else.

Completed sheets are shown in figure 5.

HABITAT DATA

Area within 50 m edge of plot

Stratum no. (Bog) 2 Plot no. 1

3 Recorder RB+PAB 4 Date 4/3/74

AQUATIC HABITATS

5 Pool (<1m²)	10 Muddy bottom	15 Rocky spring	20 Water trickle
6 Pond (1-20m ²)	11 Peat bottom	16 Peat spring	21 Seepage
7 Lake (>20m ²)	12 Sandy bottom	17 Dry ditch	22 Drowned peat etc
8 Slow rvr/strm	13 Gravel bottom	18 Wet ditch	23 River bank
9 Fast rvr/strm	14 Rocky bottom	19 Marsh/bog	24 River cutting

ANIMALS

25 Sheep	28 Rabbit	31 Many droppings	34 Carcass/bones
26 Cattle	29 Vegetation btm	32 Sheep lay	35 Earthworms
27 Pony	30 Few droppings	33 No grazing	

MANAGEMENT

36 Wall	43 Croft	50 Sheep enc.	57 Metalled road
37 Ruined wall	44 Ruined croft	51 Ruined enc.	58 Midden
38 Embankment	45 Occupied house	52 Domestic rubbish	59 Recent burning
39 Peat diggings	46 Unoccupied hse	53 Other rubbish	60 Past burning
40 Fence	47 Ruined house	54 Path (<1 m)	61 Quarry/excavation
41 Ploughing	48 Other bldg in use	55 Track (1-5 m)	62 Peat stacks
42 Drain lines	49 Othr ruined buldgs	56 Hardcore track	

LAND USE AND LANDFORMS

63 Rough grazing	67 Sea cliff	71 Wet bog	75 Dunes
64 Improved grazing	68 Rocky shore	72 Blanket peat	76 River gorge
65 Arable	69 Sandy/mddy shore	73 Grassland	
66 Other human actvty	70 Pebble shore	74 Saltmarsh	

OTHER NOTES

(e.g. Geology of the area; any birds; insects or other animals noted around the plot; other comments)

Whole area on blanket peat; very wet in parts. Some small outcrops of basal conglomerate and red sandstone. Heavy grazing on whole area; no fences, & easily accessible from road.

HABITAT DATA
Area within 50 m edge of plot

Stratum no. (*Serpentine*) 2 Plot no. 2

3 Recorder RB + PAB 4 Date 5/3/74

AQUATIC HABITATS

5 Pool (<1m ²)	10 Muddy bottom	15 Rocky spring	20 Water trickle
6 Pond (1-20m ²)	11 Peat bottom	16 Peat spring	21 Seepage
7 Lake (>20m ²)	12 Sandy bottom	17 Dry ditch	22 Drowned peat cu
8 Slow rvr/strm	13 Gravel bottom	18 Wet ditch	23 River bank
9 Fast rvr/strm	14 Rocky bottom	19 Marsh/bog	24 River cutting

ANIMALS

25 Sheep	28 Rabbit	31 Many droppings	34 Corpse/bones
26 Cattle	29 Vegetation btm	32 Sheep lay	35 Earthworms
27 Pony	30 Few droppings	33 No grazing	

MANAGEMENT

36 Wall	43 Croft	50 Sheep enc.	57 Metalled road
37 Ruined wall	44 Ruined croft	51 Ruined enc.	58 Midden
38 Embankment	45 Occupied house	52 Domestic rubbish	59 Recent burning
39 Peat diggings	46 Unoccupied hse	53 Other rubbish	60 Past burning
40 Fence	47 Ruined house	54 Path (<1 m)	61 Quarry/excavati
41 Ploughing	48 Other bldg in use	55 Track (1-5 m)	62 Peat stacks
42 Drain lines	49 Othr ruined buldng	56 Hardcore track	

LAND USE AND LANDFORMS

63 Rough grazing	67 Sea cliff	71 Wet bog	75 Dunes
64 Improved grazing	68 Rocky shore	72 Blanket peat	76 River gorge
65 Arable	69 Sandy/mddy shore	73 Grassland	
66 Other human actvty	70 Pebble shore	74 Saltmarsh	

OTHER NOTES

(e.g. Geology of the area; any birds; insects or other animals noted around the plot; other comments)

Whole area on serpentine, with shallow soils, many rock outcrops and rocks among vegetation. Grazing over whole area (sheep & pony droppings noted).

Finishing the plot

When you have done all this, the recording of the plot is now complete. Make sure you have entered the stratum and plot numbers on all 4 sheets, and that the sheets have been fully filled in. Check that you have taken a soil sample, and that this, and any unidentified plants you have collected, are in polythene bags labelled clearly with stratum and plot number. Make certain that you have collected together all your equipment and samples into the rucksack. You can now move onto the next plot, and start the whole procedure all over again.

The completed field sheets in this handbook (figures 2a - 5a and 26 - 56), are actual data sets collected during a short visit to Shetland in March this year. One set, labelled "Stratum (Bog)" (figures 2a - 5a) was collected on blanket bog overlying deep peat a few miles outside Lewick (grid reference HU 443429). The other set, labelled "Stratum (Serpentina)" (figures 26 - 56) was collected on grassland overlying the serpentine rocks on Unst, the northernmost large island of Shetland (grid reference HP 636113).

Apart from showing how to fill in field sheets, these are intended to give you some slight idea of what plants may be found in Shetland, and is mainly for those of you that have not been there before.

Appendix 1

List of survey equipment provided

1 rucksack

1 set plot-marking equipment

1 spade

2 recording boards and pencils

Data sheets

1 ruler

1 soil auger and handle

1 Silva compass

1 clinometer

Polythene bags

Aluminium labels
(for polythene bags)

Maps.