Northern Ireland Countryside Survey 2007: Quadrat Survey – Field Methods and Technical Manual

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Research and Development Series 13/02

A report commissioned by the Northern Ireland Environment Agency

Northern Ireland Countryside Survey 2007:

Quadrat Survey – Field Methods and Technical Manual

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NIEA contract number: CON 2/1 (182)

This report should be cited as follows:
McCann, T., Rogers, D. and Cooper, A. (2012) Northern Ireland Countryside Survey NICS2007: Field Boundary - Summary Report 1998-2007. *Northern Ireland Environment Agency Research and Development Series* **No.13/02**, Belfast.

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Prologue

Northern Ireland Countryside Survey
In the late 1980s, a baseline land cover survey was carried out in Northern Ireland (NI) to estimate the area of different types of habitats from a random sample set of quarter kilometre (25ha) grid squares. A monitoring resurvey was carried out in 1998 to determine the extent of change using the same sample grid squares and methods as in the baseline. A third time series of the NICS was carried out in 2007 to survey 287 sample grid squares at a proportional sampling intensity of 0.5% across the NI landscape

The methodology of NICS2007 was more detailed: the percentage cover of the main species was recorded; attributes were added to take account of habitat condition, structure and management (McCann et. al., 2007); field data recording was carried out electronically using a PDA with integrated differential GPS.

Quadrat Survey
NICS2007 land cover has been fully digitised and contains information on woodland, seminatural vegetation, agricultural grassland, crops, waterbodies and the built environment. The field mapped habitat parcels within the NICS sample squares are stored as digital polygons with associated databases containing attribute information on habitat type, ecological condition, structure and management. The mapped parcels of any particular habitat type are referred to as a statistical population in quadrat survey.

The rationale behind quadrat survey is to supplement the habitat attribute data with an assessment of current species composition.

Quadrat Survey Handbook Structure
Standard field procedures for quadrat survey are provided within this manual. They are described in sections:

Part 1. Field procedures for quadrat location, survey, layout and for species and environmental attribute recording.

Part 2. Electronic field data form recording procedures.

Part 3. Species group recording.

Note: refer to the NICS2007 habitat field survey manual (McCann et. al., 2007) for habitat descriptors and survey procedures.

NICS2007 Quadrat Survey Field Manual: PART 1.

Field Methods

CONTENTS

PART 1. FIELD METHODS

Introduction

The NICS2007 habitat mapping field manual (McCann et. al., 2007) should be consulted for sections on habitat survey procedures, biosecurity and health and safety issues. It is important that when seeking permission for access on a farm, that boots, clothing and vehicles are clean and that biosecurity procedures have been followed. Field surveyors should always work in pairs and follow safety procedures.

Data Recording

Data is recorded electronically with a PDA with integrated differential GPS (see Part 2). A quadrat survey data folder is provided for each NICS sample square and should be consulted prior to field work.

Quadrat Survey Data Folders

The quadrat survey data folder provided for each NICS sample square has the following components:

- work schedule sheet
- NICS2007 land cover map digital print
- Colour aerial photo
- permission sheets (updated)
- quadrat location/sketch maps
- emergency paper data recording sheets

Work Schedule Sheet

The OS 6 figure grid reference location (bottom left corner) of the NICS sample square is provided. A list of quadrats to be surveyed, with location, NICS habitat type and PDA filename is also given on the work schedule sheet (Appendix 1). Quadrat location is also shown on the PDA background map for each NICS sample square. Work schedule sheets should be signed, dated and annotated as part of field survey.

NICS2007 Land Cover Map Digital Print

A colour land cover map digital print at 1:5000 scale with mapped parcels labelled.

Aerial Photo

A recent aerial photo at 1:5000 scale with the outline of the sample square delimited.

Permission Sheets

A permission notes sheet and a 1:10000 NICS sample square location map are provided. Existing permission sheets have been provided for those sample squares in which permission data has been recorded previously. These should be edited with any new information.

New permission sheets have been provided for those sample squares in which permission data has not been recorded previously. These must be annotated with any relevant information. Reference the land by letter “A” etc., and mark on the 1:10000 map. Up-to-date permission sheets are essential as many of the sample squares will be revisited and this will save time in the field.

Quadrat Location / Sketch Map

If quadrat location has been done by measurement rather than by GPS (e.g. if there is insufficient satellite reception) then a detailed location map with all measurements and compass directions should be drawn up. If there are any notable features within

a plot, such as a large rock or stream then these should also be drawn on a map even if the plot has been located by GPS. If a 5m x 20m quadrat layout has been used then a note should be made on the work schedule sheet. All compass directions should be included.

Emergency Paper Data Recording Sheets
In the unlikely event of PDA failure, emergency paper data recording sheets are provided for species and environmental variables,

Habitat Mosaics
Occasionally a parcel may be recorded as a habitat mosaic, e.g. where mixed patches of different habitats greater than the NICS minimum mapping area (100m^2 = 0.01ha) cannot be mapped separately. These have a double labelled polygon on the land cover map digital print. The % cover of each habitat within the mosaic is noted on the work schedule sheet. Make sure that the quadrat is recorded in the allocated habitat and move the plot if appropriate.

Checking Habitat Type Change
Generally all quadrats are surveyed. However check that the mapped habitat parcel has not been reclaimed, re-seeded etc., causing the parcel to have changed habitat type. Other agricultural grassland (A11) can often be reseeded to Ryegrass (A08). The NICS2007 habitat mapping field manual contains habitat species composition details which will help with decision making. If the parcel has changed habitat type then make a written note beside the quadrat details on the work schedule sheet.

Cover Values
Cover values used in NICS quadrat survey equate to the Domin scale (Table 1.).

Table 1. Cover values used in NICS quadrat survey.

Value	Range (%)	Descriptor
1.	+	present but no measurable cover, i.e. close to 0.1%
2.	< 1	measurable cover but less than 1%
3.	1 - 4	1% to 4% inclusive
4.	5 - 10	5% to 10% (1\10) inclusive
5.	11 - 24	greater than 10% (1/10) to less than 25% (1/4)
6.	25 - 33	about 25% (1/4) to 33% (ca. 1/3)
7.	34 - 49	34% (ca. 1/3) to less than 50% (1/2)
8.	50 - 74	50% (1/2) to less than 75% (3/4)
9.	75 - 89	75% (3/4) to less than 90% (9/10)
10.	90 - 100	90% (9/10) to 100%

Figure 1. gives an aid to visual interpretation of cover/abundance threshold values. Note that when estimating high values of percentage cover for a species it is useful to compare this with the inverse, i.e. the percentage not covered. The quadrat outline is projected vertically, therefore the cover of any over-hanging plant species is included even if they are not rooted within the quadrat.

Species Identification / Nomenclature

A PDA list of species with full botanical latin binomial denoting genus and species is provided for each quadrat survey. Note: species encountered during the course of quadrat survey which are not on the PDA list, should be recorded by botanical latin name, cover and height values where appropriate. Standard floras are essential for a reliable identification of any unknown specimens. If confirmation of identification is required, bring in a specimen sealed in a poly bag labelled with quadrat ID and PDA species number. The project staff will confirm ID. Garden escapes can be difficult to identify and may be allocated to genus level if necessary

Trees and shrubs are additionally classified by height class, i.e. <1.3m, 1.3m – 5m and >=5m. This matches the recording methodology of NICS2007 woodland habitat survey. The branches of shrubs/trees can overhang the plot at any height level contributing to species cover. Shrubs/trees should always be recorded by their actual height class regardless of at what height their branches overhang the plot.

Details of species aggregates and species group types are listed in Part 3.

In the field, surveyors should check that each species has an associated cover value before completion of the PDA data file.

Post-survey Data Editing

Recorded field data will be downloaded from the PDAs on a weekly basis. Paper print-outs of quadrat data are produced as back-up. Any unknown species which have been identified in the lab should be clearly annotated on the paper print-out, correctly spelling species using their full botanical latin name. Names should be printed in block capitals as handwriting can be illegible. The associated data file can then be updated electronically.

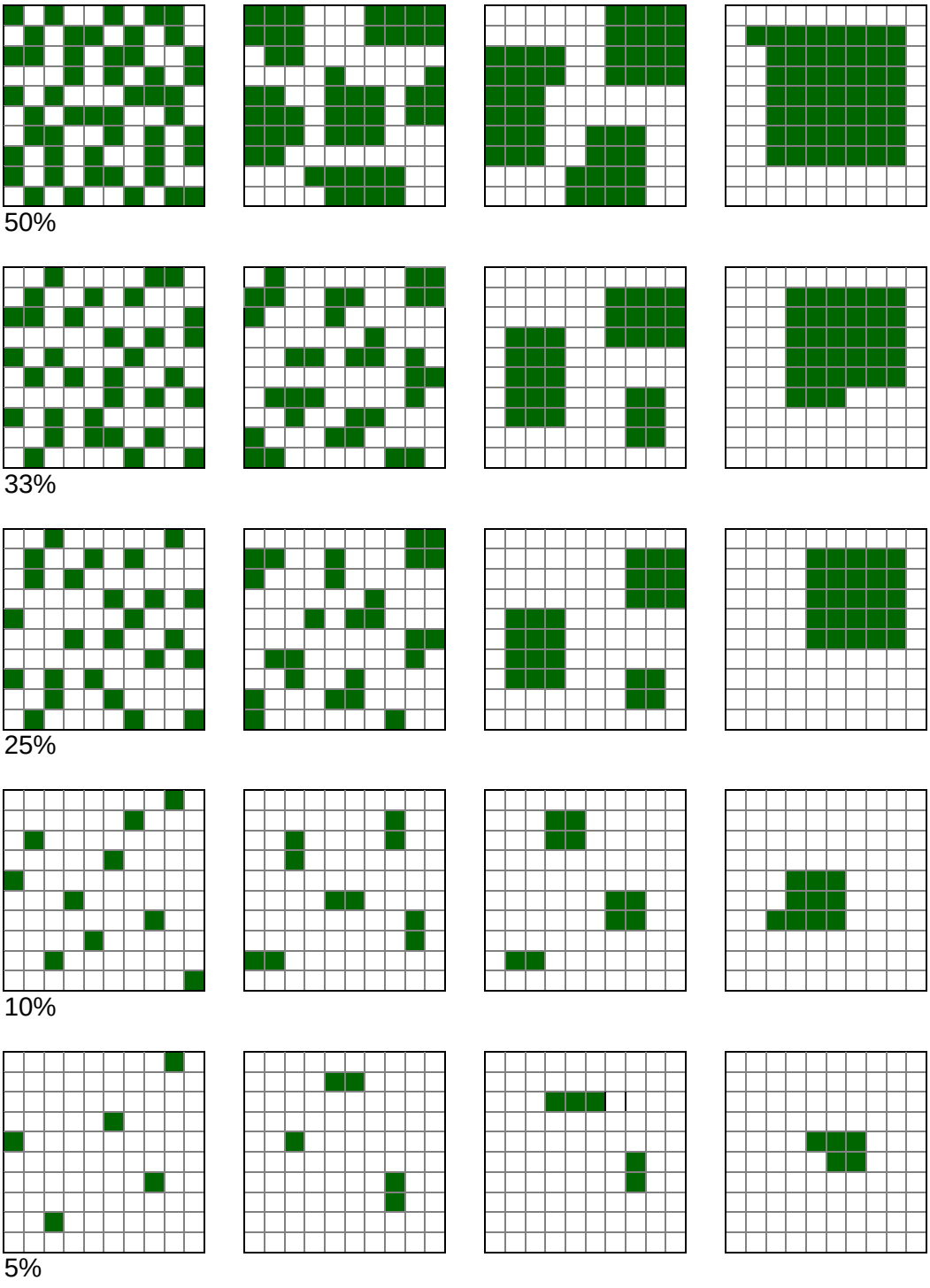


Figure 1. An aid to visual interpretation of NICS cover/abundance threshold values in quadrats. For each threshold cover value, distributions range from scattered on the left to patches/clumps on the right. Note that 1 grid cell equates to 1% cover of the square. In a $100m^2$ quadrat 1 grid cell is 1m x 1m and in a $4m^2$ quadrat a grid cell is 20cm x 20cm. Threshold cover values of 75% and 90% are the inverse of 25% and 10% respectively. Cover values < 5% are not shown.

1. Woodland Quadrats

Quadrat size is 10m x 10m (i.e. 100m^2). Ground flora and woody canopy species are recorded within the plot. As woodland parcels can follow the form of the landscape in strips (e.g. alongside streams), a 5m x 20m quadrat layout may occasionally be necessary.

Quadrat Location

The OS 6-figure grid reference location of quadrats, with NICS habitat type and PDA filename is given on the work schedule sheet (Appendix 1) within which detail is provided for each NICS sample square. Quadrat location is also shown on the PDA background map for each NICS sample square.

Quadrat Layout 10m x 10m

Locate quadrat position by a 6-figure grid reference for the bottom left corner (BLC), orientated facing north. Use GPS or measuring tape. If there is a location problem, relocate the quadrat to avoid this (see Page 7). There are 4 corner poles with attached lines measured to 7.07m and one centre pole with clips.

1. Insert a quadrat pole at the bottom left corner (BLC) (Fig. 2).

2. Connect the attached line to the centre pole. Insert the centre pole directly NE of the BLC making sure that the line is taut. The attached lines are already measured to 7.07m.

3. Connect another line to the centre pole and insert the quadrat pole directly NE of the centre. This is the top right corner pole and forms the first diagonal of the 10m x 10m quadrat.

4. Connect another line to the centre pole and insert the quadrat pole directly NW of the centre. This is the top left corner pole.

5. Connect the final line to the centre pole and insert the quadrat pole directly SW of the centre. This is the bottom right corner pole and forms the second diagonal of the 10m x 10m quadrat. The 4 corner poles now outline the quadrat square.

Quadrat Layout 5m x 20m

As woodland parcels can follow the form of the landscape in strips, 5m x 20m quadrat layouts may be necessary. These are still displayed by the nearest 10m x 10m grid on the PDA map. The 5m x 20m quadrat (Fig. 3.) should be moved so that it is within the parcel and positioned to follow the orientation of the parcel in the landscape. An extra quadrat pole and extension lines are provided so that there are 2 poles at each end of the 20m plot with 2 centre poles placed at the 10m mid-point. The first 2 end poles are inserted such that the line BLC to TLC is 5m long and points in a northerly direction ranging from West to East. The remaining 2 sets of poles are inserted at 10m intervals with the measured lines provided and keeping opposite poles 5m apart. The 3 sets of matching poles now form a 5m x 20m quadrat. Note that the direction of the BLC to BRC line requires measurement by compass.

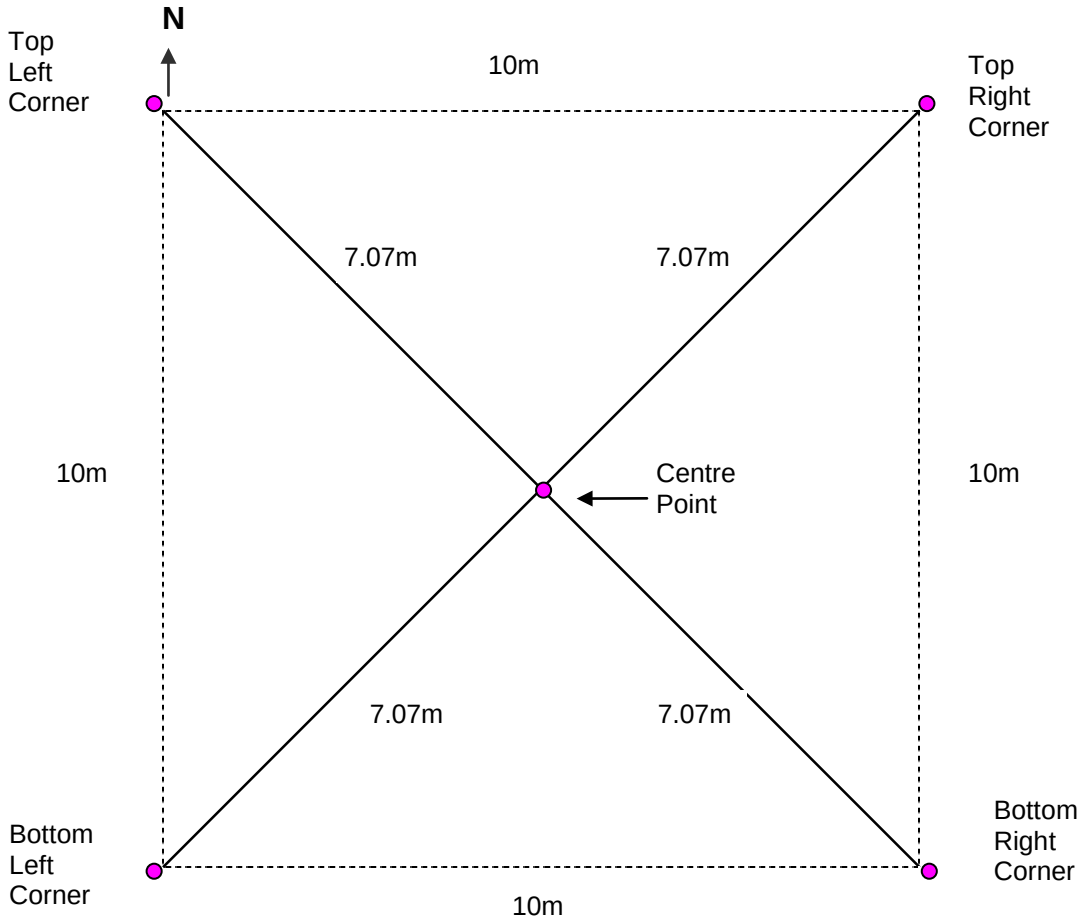


Figure 2. Layout of a 10m x 10m (100m^2) quadrat. Scale: 1cm = 1m.

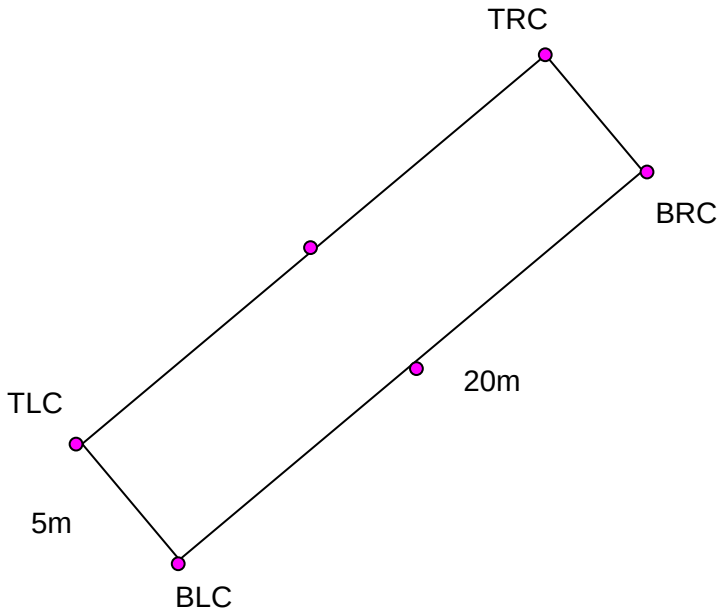


Figure 3. Example layout of a 5m x 20m (100m^2) quadrat. Scale: 4mm = 1m.

Quadrat Relocation
Quadrat location is given to the nearest 10m, i.e. as if a 10m x 10m grid was overlaid on the 25ha sample square (500m x 500m). If there is a location problem such as in:

- "established" woodland parcels where the quadrat placement results in less than 25% cover of woody species canopy > 5m.

- "transitional" woodland parcels where the quadrat placement results in less than 25% cover of "tree" species (i.e. species tending to grow naturally to tree growth forms). Note: scrub parcels must have 25% cover of species such as eg. *Crataegus monogyna* or *Prunus spinosa*. Scrub parcels dominated by eg. gorse and broom have been omitted from the sampling programme.

Relocate the quadrat to avoid this. In large parcels which easily accommodate 10m x 10m quadrats the quadrat can be moved 5m/10m East firstly or North. For 5m x 20m quadrats move the BLC 5m following the direction of the parcel in the landscape.

Quadrat Sketch Map
If measurements are made to locate/place a quadrat, a quadrat sketch map must be drawn. This should have distances, arrows, compass bearings and should be legible and clear. Mark features such as ditches to aid location.

Cover Values
Cover values used in NICS quadrat survey equate to the Domin scale (Table 1.). Figure 1. gives an aid to visual interpretation of cover/abundance threshold values in quadrats. As a useful aid to % cover assessment, a 1m by 1m grid equates to 1% cover of the 10m x 10m ($100m^2$) quadrat. The 4 corner poles outline the quadrat square. The diagonals intersect the quadrat to form 4 quadrants i.e. N, E, S & W. This also facilitates a structured assessment of species presence and cover by walking each quadrant in turn.

Species Recording
The quadrat outline is projected vertically, therefore the cover of any over-hanging plant species is included even if they are not rooted within the quadrat. The branches of shrubs/trees can overhang the plot at any height level contributing to species cover. Trees and shrubs are additionally classified by height class, i.e. <1.3m, 1.3m – 5m and >=5m. Shrubs/trees should always be recorded by their actual height class regardless of what height their branches overhang the plot.

1.1 Woodland Quadrat Environmental Variables

All environmental variables are recorded within the $100m^2$ plot.

Bryophyte Cover (%)
Record the total cover of all bryophytes (%). This is the combined cover of mosses and liverworts on the ground. It does not include species growing on rock outcrops, surface boulders or trees.

Lichens (bushy) Cover (%)
Record the combined cover of all bushy (fruticose) lichens. Bushy lichens recorded by NICS include bearded and antler-horn types, e.g. *Cladonia portentosa/impexa* and other similar species such as *Cladonia arbuscula* and *Cladonia uncialis*. This does not include "matchstick" *Cladonia* species.

Leaf Litter Cover (%)
This represents the percentage of the plot that is covered with a thick leaf litter. Only the cover of clearly visible leaf litter observed without parting the vegetation is recorded.

Canopy Cover 1.3m - 5m (%)
Record the total canopy cover of shrubs/trees in the 1.3m to 5m height zone projected vertically above the plot. Cover is estimated within the $100m^2$ plot outline by projecting upwards. Include all leaves and branches overlying the plot in this zone even if the shrub/tree is not rooted within the $100m^2$ quadrat and regardless of whether the branch is from a >5m or 1.3m – 5m shrub or tree height class.

Canopy Cover >5m (%)
Record the total canopy cover above the 5m height threshold projected vertically above the plot. Cover is estimated by viewing the canopy (>5m) projected upwards within the $100m^2$ plot outline. Include all leaves and branches of trees overlying the plot above 5m even if the tree is not rooted within the quadrat.

Grazing (Intensity)
Record grazing intensity as :

- no signs

1. ***Light***: well-developed understorey with no obvious woody shoots pruned. Ground vegetation with graze-sensitive species such as bramble (*Rubus fruticosus*), honeysuckle (*Lonicera periclymenum*) and ivy (*Hedera helix*). Occasional physical evidence of grazing by animals such as hoof marks.

2. ***Moderate***: patchy understorey, with frequent evidence of woody shoot pruning and grazed ground flora. Ground vegetation with some close-cropped areas.

3. ***Heavy***: absence of shrub layer. Browse line on trees and shrubs. Most ground vegetation close-cropped (<10cm tall). Abundant dung, paths, bare ground or other signs of grazing animals such as hoof marks.

Poaching (+/-)
Record as present if poaching has created current bare soil. The physical evidence of poaching is: bare patches or holes with bare soil created by the hooves of farm stock. Hoof marks that have not created bare soil or poach-holes with re-grown vegetation are not included.

Bare Soil (%)
Record the cover (%) of bare soil, i.e. mineral/peat/mud/sand without a ground flora. Rock outcrops, surface boulders and leaf litter are not included. Only the cover of clearly visible bare soil observed without parting the vegetation is recorded.

Burning (+/-)
Record if present. The physical evidence of burning is charred stems or blackened ground.

Surface Rock/Boulders (%)
This includes rock outcrops (> ca. 50cm at widest point) and surface boulders (> ca. 20cm at widest point) on top of or protruding from the soil surface. They are often moss covered. Record a cover value.

Limestone Pavement (+/-)
The weathering of bare limestone produces 'paving' blocks known as clints, the fractures are grikes and the gutter like features that cut the clints and drain into the grikes are called runnels. Most of the pavement in NI is quite fragmented and occurs as part of a natural habitat mosaic comprising bare pavement, pockets of mineral soils and peat which has subsequently covered some of the limestone. There is often patchy cover of stunted hazel (*Corylus avellana*) sometimes with small ash (*Fraxinus excelsior*). Under dense woody cover, the surfaces of the clints can be covered with woodland mosses.

Woodland Management
Record as present where applicable, up to 2 types.

- **A.** ***Thinning***: evidence of recent selective felling and/or removal of trees. Cut/sawn stumps without moss etc. and bare ground and brash piles present.
- **B.** ***Felling***: recent clear-felling.
- **C.** ***Coppice***: most trees multiple-stemmed and even aged, except for occasional unfelled standards.
- **D.** ***Brashing***: ground clearance and disturbance evident, with the trunks of trees cleared of lower branches and/or unplanted trees or shrubs cut.
- **E.** ***Planting***: new plantings (usually <1.3m) within existing woodlands or a new plantation with a uniform size structure and spacing.

Dead Wood (+/-)
Standing or fallen tree/s (> 20cm diameter). Record if present.

Wind-Blow (+/-)
Wind-blown and or wind-snapped trees, often still living. Record if present.

Dumping
Record the presence of dumping within the plot as:

- **A.** ***Earth/spoil*.**
- **B.** ***Rubbish*.**
- **C.** ***Abandoned vehicles*.**

Flush (+/-)
Seepage spring associated with slope. Record if present.

Slope (°) Class
Categories are:

Scale	*Range*
0.	approximately level (ca. 0°)
1.	gentle (<10°)
2.	moderate (10° – 20°)
3.	steep (>20°)

Aspect (°)
Measure the aspect in degrees by compass looking straight down the slope. An aspect which is directly North is recorded as 360°. If the slope is approximately level (ca. 0°) then the aspect is recorded as 0°.

2. Grassland Quadrats

Quadrat size is 2m x 2m (i.e. 4m^2) for grassland habitats.

Quadrat Location

The OS 6-figure grid reference location of quadrats, with NICS habitat type and PDA filename is given on the work schedule sheet (Appendix 1) within which detail is provided for each NICS sample square. Quadrat location is also shown on the PDA background map for each NICS sample square. Each 2m x 2m plot is located centrally within a random 10m x 10m grid. If there is a location problem, relocate the quadrat (see Page 11).

Quadrat Layout

Locate quadrat position by a 6-figure grid reference for the bottom left corner (BLC), orientated facing north. GPS should normally work in open grassland areas, if not, use a measuring tape and compass bearings, and produce a sketch map. There are 4 quadrat pegs (one for each corner) with 2m lines already attached. Insert the bottom left corner (BLC) quadrat peg (Fig. 4). Insert the top left corner (TLC) peg directly North of the BLC, making sure that the attached line is taut. Insert the top right corner pole directly West of the TLC. Now attach the line end loop to the BLC peg and insert the bottom right corner peg directly East of the BLC, both attached lines should be taut.

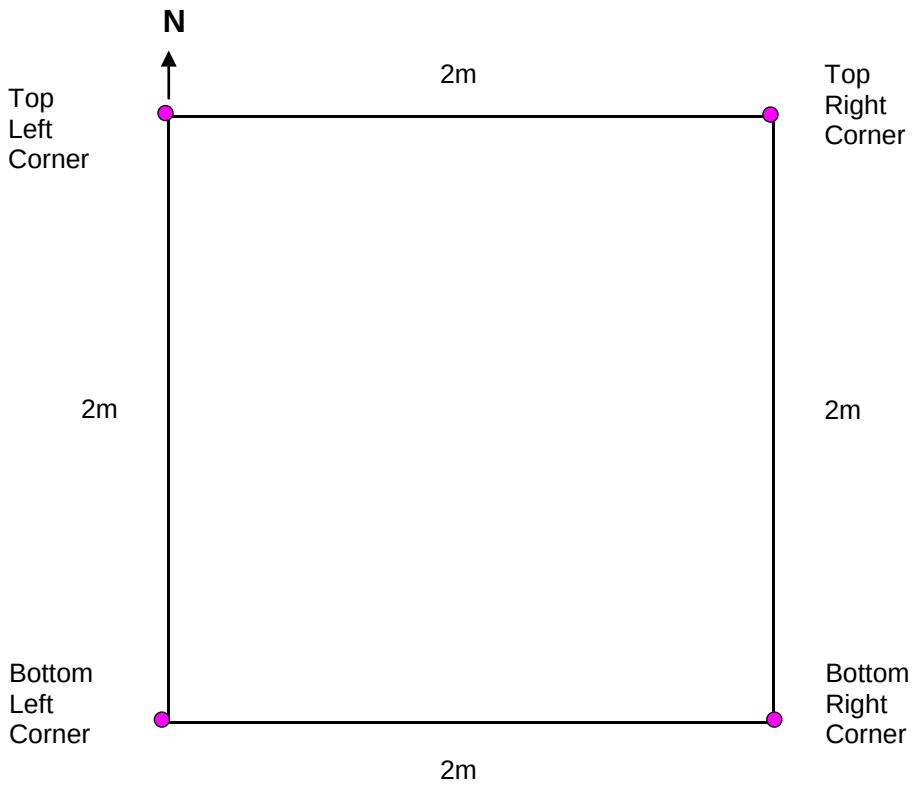


Figure 4. Layout of a 2m x 2m (4m^2) quadrat. Scale: 4cm = 1m.

The 4 corner pegs outline the quadrat square. Diagonal lines are not required but check that the diagonal measures 2.83m, i.e. the quadrat layout is square.

Relocating Quadrats
Each 2m x 2m (4m^2) plot is located within a random 10m x 10m grid (Fig. 5.). Any of the 25 x 4m^2 quadrats could be taken at random, however the central one is taken (Fig. 5.) as the resolution of the GPS is limited to 1m – 3m.

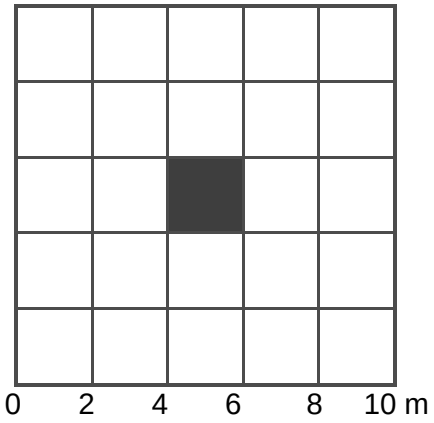


Figure 5. A 10m x 10m (100m^2) sub-unit showing the 25 2m x 2m (4m^2) plots with central quadrat location, scale 5mm = 1m.

The habitat survey methodology of NICS2007 records patches of bare soil/peat, bare rock and tree/shrub etc. which are less than the minimum mapping area ie. 100m^2 (0.01ha) as land cover attributes of habitat parcels. It is possible that the quadrat could occur in such patches. Obtaining species composition data for the habitat parcel takes priority. Quadrats must be relocated if there is a problem such as:

- bare ground covering 75% or more
- a tree or large shrub rooted in the 2m x 2m plot
- a large boulder occupying most of the plot (uncharacteristic of the parcel)
- a drain or ditch
- less than 25% habitat cover as a result of some of the above

If, for example, bare soil covers 75% or more of the quadrat, then move it 2m East, West, North or then South until >25% vegetation cover is achieved. Remember to take a GPS point for the BLC of the new location and make a field note.

Note that if bare ground etc., greater than the minimum mapping area is due to a land use change within the parcel since 2007, then this should be annotated as land cover change on the work schedule sheet.

Cover Values
Cover values used in NICS quadrat survey equate to the Domin scale (Table 1.). Figure 1. gives an aid to visual interpretation of cover/abundance threshold values in quadrats. A useful aid to % cover assessment, is a 20cm by 20cm grid, which equates to 1% cover of the 2m x 2m (4m^2) quadrat.

Species Recording
Include all species which over-hang the plot.

2.1 Grassland Quadrat Environmental Variables

All environmental variables are recorded within the $4m^2$ plot.

Herbs (%)
Herbs comprise all broadleaf herbaceous species (including Agricultural Weeds). Excluded are grasses, sedges, rushes, ferns, mosses and trees/shrubs. Record total combined cover.

Agricultural Weeds (%)
Record the combined cover of agricultural weed species. These comprise only the five species: spear thistle (*Cirsium vulgare*), creeping or field thistle (*Cirsium arvense*), curled dock (*Rumex crispus*), broad-leaved dock (*Rumex obtusifolius*) and common ragwort (*Senecio jacobaea*).

Rushes (%)
Record the combined cover of all rush species, i.e. *Juncus sp*. only. Soft rush (*Juncus effusus*) forms tussocks whereas the individual shoots of sharp flowered/jointed rush (*Juncus acutiflorus/articulatus*) are more difficult to see, particularly in newly mown swards.

Grasses (%)
This is the combined % cover of all grasses, i.e. family Gramineae, true grasses only.

Sedges (%)
This is the combined % cover of all sedges, i.e. *Carex sp*. only. Other members of the Cyperaceae family are not included in this cover.

Bryophytes (%)
Record the total combined % cover of all mosses and liverworts. It may be necessary to disturb or part the vegetation to get an accurate estimate of bryophyte cover.

Vegetation Litter (+/-)
This is dead, thatchy material of fibrous plant litter, stems/stolons etc. that has accumulated over time to form a thick mat. Vegetation litter is mainly related to the presence of "graminoids", i.e. species belonging to the Gramineae, Cyperaceae and Juncaceae families. Herbs may also contribute. It is not a measure of dead moss material such as eg. under *Sphagnum* hummocks. Record as present if there is a vegetation litter layer >5cm thick measured from the ground level. Where sites are well grazed or mown, there is likely to be little or no vegetation litter.

Vegetation Height
Record the modal (most common) height of the vegetation sward. Ignore scattered individuals, small clumps and patches (e.g. rush tussocks or flowering stems above the main canopy). Height should be recorded from ground level. It may be necessary to disturb or part the vegetation especially where a thatch has formed. A measuring tape or ruler must be used in order to record an accurate height.

Height Classes:

Scale	*Range*	*Descriptor*
1.	<= 5cm	i.e. up to 5cm inclusive
2.	6 - 15cm	i.e. greater than 5cm to 15cm
3.	16 - 30cm	i.e. greater than 15cm to 30cm
4.	31 - 49cm	i.e. greater than 30cm to less than 50cm
5.	50cm +	i.e. 50cm or more

Vegetation Cutting (+/-)
Record as present if there are physical signs of vegetation cutting. The physical evidence of cutting is cut woody flowering stems of grasses just above the soil surface, flat-topped rush tussocks, scattered hay/silage, plastic wrapped big-bales, tractor tyre tracks across the whole habitat parcel. Include rush-topping (machine-cut rush tussocks). Some swards are grazed as well as cut in the same season. It is difficult to tell early in the growing season what use they will be put to. If there is no physical evidence record uncut.

Grazing (+/-)
Record as present if there are physical signs of grazing across the whole plot. The physical evidence of grazing is: presence of animals, current or old hoof marks, dung or defoliation.

Poaching (+/-)
Record as present if poaching has created current bare soil. The physical evidence of poaching is: bare patches or holes with bare soil created by the hooves of farm stock. Hoof marks that have not created bare soil or poach-holes with re-grown vegetation are not included.

Dung (%)
Record the cover (%) in the plot.

Bare Soil (%)
Record the cover (%) of bare soil, i.e. mineral/peat/mud/sand. It is the cover of bare ground, clearly visible when looking down without disturbing/parting the vegetation. It does not include stones, surface boulders or rock outcrops. Recently burnt areas are also not included.

Stones: gravel/pebble/shingle (%)
Stones 2mm to ca. < 20cm at widest point. Record a cover value.

Surface Rock/Boulders (%)
This includes rock outcrops (> ca. 50cm at widest point) and surface boulders (> ca. 20cm at widest point) on top of or protruding from the soil surface. They can be moss covered. Record a cover value.

Slope (°) Class
Categories are:

Scale	*Range*
0.	approximately level (ca. 0°)
1.	gentle (<10°)
2.	moderate (10° – 20°)
3.	steep (>20°)

Aspect (°)
Measure the aspect in degrees by compass looking straight down the slope. Note that if the aspect is directly North this is recorded as 360°. If the slope is approximately level (ca. 0°) then the aspect is recorded as 0°.

3. Field Edge Quadrats

Quadrat size is 4m x 1m (i.e. 4m^2) for agricultural grassland field edges.

Field Edge Definition

A field edge occurs between a field boundary type and the habit parcel which the field boundary delimits. There must be >25% grassland species (i.e. Gramineae) cover. The field edge is always placed 25cm away from the base or margin of the field boundary. The placement of the field edge therefore depends on the field boundary type and structure. Detailed descriptions of field boundary type and structure are given in the NICS2007 field manual (McCann et. al., 2007).

a) for intensivey managed close-cropped hedges; banks; half-banks; walls and fences or combinations of these:
the field edge is set 25cm out from the base of whichever feature is widest.

b) for ditches or boundaries with associated ditches:
the field edge is set 25cm out from the top of the ditch on the side nearest to the agricultural parcel with which it delimits.

c) for hedges with woody out-growths:
the field edge must be set 25cm out from the margin of the woody out-growths.

d) for large over-grown and over-hanging hedges:
the field edge must be set 25cm out from the point where there is >25% grassland species (i.e. Gramineae) cover, as there can be a semi-woodland ground flora layer in some cases.

Note that internal drainage ditches within habitat parcels which do not delimit the parcel are not counted as field boundaries. However, ditches associated with, (i.e. alongside) other field boundary types are included.

Quadrat Location

The OS 6-figure location of agricultural grassland quadrats is given on the work schedule sheets within which detail is provided for each NICS sample square. Each field edge quadrat is paired with an agricultural grassland quadrat. The field edge quadrat is located on the nearest field boundary point to the agricultural grassland quadrat with which it is paired. The field boundary must delimit the agricultural parcel within which the matching internal agricultural grassland quadrat has been allocated. This point also has to be within the outline of the NICS sample square. This has been mainly sorted in the lab prior to field survey. The OS 6-figure location of the field edge quadrat is determined in the field following the above criteria.

Relocate the quadrat if there is a location problem (see Page 15).

Quadrat Layout

There are 4 quadrat pegs (one for each corner) with 1m and 4m lines already attached. The quadrat is laid out by orientating at an angle of 90° to the linear direction of the field boundary. The top left corner (TLC) peg should be inserted on the field edge. Insert the bottom left corner (BLC) peg 1m out from the TLC (Fig. 6.) so that this line is at 90° to the field boundary. The two matching right corner pegs are inserted 4m to the right along the field edge. The 4m x 1m quadrat should be parallel to the field boundary.

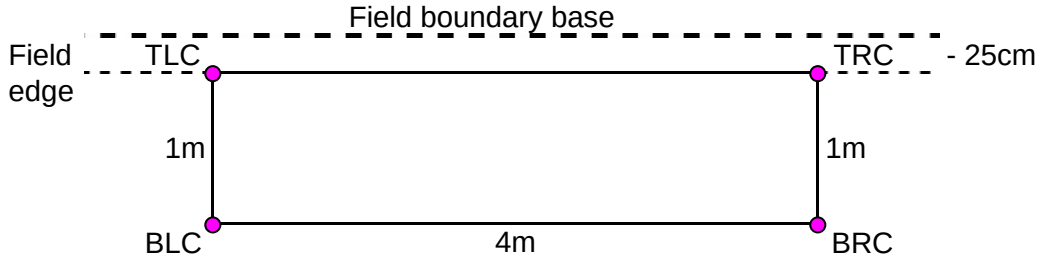


Figure 6. Layout of a 4m x 1m field edge quadrat. Scale 2cm = 1m

Relocating Field Edge Quadrats
If there is a location problem, such as:

- the quadrat runs along a gate or a gap where there is no field boundary
- there is less than 25% grassland species (Gramineae) cover because of bare ground due to poaching or because there is a semi-woodland ground layer etc.,

the quadrat can be relocated at 2m intervals along the field boundary.

Occasionally a clearly identifiable "field margin", usually fenced off as part of the Countryside Management Scheme may be present. If this is the case then allocate the field edge quadrat into the field margin, ie. within the fenced off bit. Make a note on the work schedule sheet.

Cover Values
Cover values used in NICS quadrat survey equate to the Domin scale (Table 1.). Figure 1. gives an aid to visual interpretation of cover/abundance threshold values in quadrats. A useful aid to % cover assessment, is a 20cm by 20cm grid, which equates to 1% cover of the 4m x 1m ($4m^2$) quadrat.

Species Recording
Include all ground layer species which over-hang the plot. Shrubs/trees in large overgrown hedges which over-hang the plot are not included.

3.1 Field Edge Quadrat Environmental Variables

Environmental variables recorded, are the same as for grassland ($4m^2$) quadrats. However the direction of the BLC peg -> BRC peg line (Fig. 6.) requires measurement by compass. Note that a line directly North is recorded as 360°. Insert the compass bearing into the query box on the PDA. Also make a written note beside the quadrat detail on the work schedule sheet.

4. Heath and Bog Quadrats

Quadrat size is 2m x 2m (i.e. 4m^2) for heath and bog habitats.

Quadrat Location

The OS 6-figure grid reference location of quadrats, with NICS habitat type and PDA filename is given on the work schedule sheet (Appendix 1) within which detail is provided for each NICS sample square. Quadrat location is also shown on the PDA background map for each NICS sample square. Each 2m x 2m plot is located centrally within a random 10m x 10m grid (Fig. 5.). Where two different habitats have been mapped as a mosaic within a single parcel outline (GIS polygon) then the plot must be moved into the habitat type which is being sampled.

Quadrat Layout

Layout is the same as for grassland plots (Fig. 4.). If the quadrat spans a feature such as a pool, peat hag or drain, place the quadrat horizontally and project down to assess % cover. Ensure that the plot size is 2m x 2m.

Quadrat Relocation

Generally quadrats are not moved in heath and bog habitats. There is usually at least 25% cover of vegetation within the 2m x 2m plot. The habitat survey methodology of NICS2007 records patches of bare soil/peat, bare rock and trees/shrubs etc. which are less than the minimum mapping area (i.e. 100m^2 or 0.01ha) as land cover attributes of habitat parcels. It is possible that the quadrat could occur in such patches. Obtaining species composition data for the habitat parcel takes priority. Quadrats must be relocated if there is a problem such as:

- bare soil/peat covers 75% or more
- bare rock covers 75% or more
- a patch of scrub covers 75% or more of the plot. This might be, e.g. a patch of gorse-dominated scrub which is less than the minimum mapping area and so not mapped.
- open water cover 75% or more, due to a deep permanent pool or ditch which is un-vegetated, i.e. without aquatic vegetation species such as *Sphagnum sp.*, bogbean (*Menyanthes trifoliata*) or bottle sedge (*Carex rostrata*). Note: areas with aquatic algae, eg. *Chara sp*. count as open water.

If, for example, bare soil covers 75% or more of the quadrat, then move it 2m East, West, North or then South until >25% vegetation cover is achieved. Remember to take a GPS point for the BLC of the new location and make a field note.

Note that if bare ground etc., greater than the minimum mapping area is due to a land use change within the parcel since 2007, then this should be annotated as land cover change on the work schedule sheet.

Cover Values

Cover values used in NICS quadrat survey equate to the Domin scale (Table 1.). Figure 1. gives an aid to visual interpretation of cover/abundance threshold values in quadrats. A useful aid to % cover assessment, is a 20cm by 20cm grid, which equates to 1% cover of the 2m x 2m (4m^2) quadrat.

Species Recording

Include all over-hanging species. Only the % cover of <u>living</u> dwarf shrub plants, e.g. *Calluna vulgaris* is recorded. <u>Note</u>: bare stems of partly-leaved living dwarf shrub plants are included in the % cover of those plants. The % cover of dead dwarf

shrubs, as in dieback associated with, e.g. burning, grazing or heather beetle damage is recorded in the environment file.

Trees and shrubs rooted within the plot and/or overhanging are recorded in the species file with height classes as for woodland quadrats.

4.1 Heath and Bog Quadrat Environmental Variables

All environmental variables are recorded within the $4m^2$ plot. They are mainly used to assess habitat condition.

Herbs (%)
Herbs comprise all broadleaf herbaceous species (including Agricultural Weeds). Excluded are grasses, sedges, rushes, ferns, mosses and trees/shrubs. Record total combined cover. Examples of herbs in bogs are bog asphodel (*Narthecium ossifragum*) and heath cinquefoil (*Potentilla erecta*).

Agricultural Weeds (%)
Record the combined cover of agricultural weed species. These comprise only the five species: spear thistle (*Cirsium vulgare*), creeping or field thistle (*Cirsium arvense*), curled dock (*Rumex crispus*), broad-leaved dock (*Rumex obtusifolius*) and common ragwort (*Senecio jacobaea*).

Rushes (%)
Record the combined cover of all rush species, i.e. *Juncus sp*. only. Soft rush (*Juncus effusus*) forms tussocks whereas the individual shoots of sharp flowered/jointed rush (*Juncus acutiflorus/articulatus*) are more difficult to see, particularly in newly mown swards.

Grasses (%)
This is the combined % cover of all grasses, i.e. family Gramineae, true grasses only. Deer-grass (*Scirpus cespitosus*) and cotton-grasses (*Eriophorum sp*.) belong to the Cyperaceae family and are not included.

Sedges (%)
This is the combined % cover of all sedges, i.e. *Carex sp*. only. Other members of the Cyperaceae family are not included in this cover.

Sphagnum (%)
Record the combined cover of all *Sphagnum* species. It may be necessary to disturb or part the vegetation to get an accurate estimate of *Sphagnum* cover.

Bryophytes (%)
Record the combined % cover of all mosses (including *Sphagnum sp*.) and liverworts. It may be necessary to disturb or part the vegetation to get an accurate estimate of bryophyte cover.

Lichens (%)
Record the combined cover of all bushy (fruticose) lichens. Bushy lichens recorded by NICS include bearded and antler-horn types, e.g. *Cladonia portentosa/impexa* and other similar species such as *Cladonia arbuscula* and *Cladonia uncialis*. This does not include “matchstick” *Cladonia* species.

Vegetation Litter (+/-)
This is dead, thatchy material of fibrous plant litter, stems/stolons etc. that has accumulated over time to form a thick mat. Vegetation litter is mainly related to the presence of "graminoids", i.e. species belonging to the Gramineae, Cyperaceae and Juncaceae families. Herbs may also contribute. It is not a measure of dead moss material such as eg. under *Sphagnum* hummocks. Record as present if there is a vegetation litter layer >5cm thick measured from the ground level (threshold ca. 5% cover). Where sites are well grazed or mown, there is likely to be little or no vegetation litter.

Vegetation Height
Record the modal (most common) height of the main vegetation sward. Ignore scattered individuals, small clumps and patches (e.g. occasional rush tussocks or flowering stems above the main canopy). Height should be recorded from ground level. It may be necessary to disturb or part the vegetation especially where a vegetation thatch has formed. A measuring tape or ruler must be used in order to record an accurate height.

Height Classes:

Scale	*Range*	*Descriptor*
1.	<= 5cm	i.e. up to 5cm inclusive
2.	6 - 15cm	i.e. greater than 5cm to 15cm
3.	16 - 30cm	i.e. greater than 15cm to 30cm
4.	31 - 49cm	i.e. greater than 30cm to less than 50cm
5.	50cm +	i.e. 50cm or more

This value can correspond with dwarf shrub height in some cases.

Vegetation Cutting (+/-)
Record as present if there are physical signs of vegetation cutting. The physical evidence is: cut stems of grasses just above the soil surface; flat-topped rush tussocks; scattered hay/silage; plastic wrapped big-bales; tractor tyre tracks across the whole habaitat parcel; flailed heather. If there is no physical evidence record uncut. Do not include the crushed vegetation resulting from mechanical peat harvesting.

Grazing (+/-)
Record as present if there are physical signs of grazing within the plot. The physical evidence of grazing is: presence of animals, current or old hoof marks, dung, defoliation and up-rooting of dwarf shrubs.

Poaching (+/-)
Record as present if poaching by farm stock has created current bare soil. The physical evidence of poaching is: bare patches or holes with bare soil created by the hooves of farm stock. Hoof marks that have not created bare soil or poach-holes with re-grown vegetation are not included.

Dung (%)
Record the cover (%) in the plot

Bare Soil (%)
Record the cover (%) of bare soil, i.e., mineral/peat/mud/sand. It is the % area of bare soil, clearly visible when looking down. It does not include stones, surface boulders or rock outcrops. Recently burnt areas are also not included. Only the bare

soil visible without disturbing/parting the vegetation should be included in the cover estimate.

Burning (%)
Estimate the % area of bare burnt ground, clearly visible when looking down on the plot.

Stones: including gravel/pebble/shingle (%)
Stones 2mm to ca. < 20cm at widest point. Record a cover value.

Surface Rock/Boulders (%)
This includes rock outcrops (> ca. 50cm at widest point) and surface boulders (> ca. 20cm at widest point) on top of or protruding from the soil surface. They can be moss covered. Record a cover value.

Permanent Pool (+/-)
Record whether the plot falls within, or partly within, a permanent pool. Permanent pools can either be open water (i.e. un-vegetated), usually deep or be vegetated with aquatic species such as *Sphagnum cuspidatum*, bogbean (*Menyanthes trifoliata*) or bottle sedge (*Carex rostrata*). Permanent pools resulting from old peat cutting are identified by a regular shape with straight sides. Natural permanent pools are more convoluted in outline but also have distinctly straight sides. Do not record temporary pools. Remember that if open water covers 75% or more of the quadrat, then it should be relocated.

Open Water (%)
Estimate the percentage cover of open water, clearly visible when looking down. Generally only used for deep permanent pools and drains which are un-vegetated, i.e. without aquatic vegetation species such as *Sphagnum sp.*, bogbean (*Menyanthes trifoliata*) or bottle sedge (*Carex rostrata*).

Drainage (+/-)
Record the presence of drains within the plot. The physical evidence for a new or maintained functional drain is clean sides and an open bottom (depth >25cm). Old drains are largely functional but colonised with vegetation.

Erosion/Hagging (+/-)
Record if present in the plot. Includes disturbed unvegetated areas subject to erosion or hagging, which may be the result of water movement, grazing, trampling or other factors such as quad bike tracks. Erosion hags are isolated or semi-isolated islands of peat with curved bare sides.

Peat-cutting Features (+/-)
These features are: a cut edge of bare peat, regular raised banks with angular corners and straight lines (a result of hand cutting). Recent cutting is characterised by clean unvegetated sides. Old banks are often re-colonised and hidden by regrowth. Record if the feature falls within the plot.

Spread-field/Peat Cutting (+/-)
Mechanically cut peats or hand cut peats are sometimes laid out on top of non-cut vegetation parcels to dry. Mechanical cut peats are usually extracted by digger and loaded into a compressor from which they are extruded. Turf can also occasionally be cut within a habitat parcel by an extruder pulled behind tractor. Cutting is not always obvious once the turfs have been removed; look for turf fragments, a flat

micro-topography, slits in the peat and an associated impoverished species content (especially *Sphagnum sp*.). Record if present.

Dwarf Shrubs (%)
Definition: dwarf shrubs comprise the species: ling heather (*Calluna vulgaris*), *Erica sp*. the most frequent being bell heather (*Erica cinerea*) and cross-leaved heath (*Erica tetralix*), crowberry (*Empetrum nigrum*), bilberry (*Vaccinium myrtillus*), cowberry (*Vaccinium vitis-idaea*), dwarf "western" gorse (*Ulex gallii*) and bog myrtle (*Myrica gale*). In exposed situations the shoots of dwarf shrubs can be severely wind-clipped, forcing the plants to grow prostrately. Also included is wind-pruned (<50cm) European gorse (*Ulex europaeus*). Cranberry (*Vaccinium oxycoccus*) is a prostrate dwarf shrub with trailing stems.

Less common dwarf shrubs are bearberry (*Arctostaphylos uva-ursi*), dwarf willow (*Salix herbacea*) and juniper (*Juniperus communis*) either wind-pruned or the prostrate form spp. nana. Dwarf willow (*Salix herbacea*) is a constituent of heath in montane zones or on the coast. Bog rosemary (*Andromeda polifolia*) occurs as an under-shrub and is uncommon.

Record the combined cover of all dwarf shrub species in the plot. Note that this dwarf-shrub cover refers to <u>living</u> plants only, and does <u>not</u> include dead plants.

Dwarf Shrub Height Class
Record the modal (most common) height of all dwarf shrub species in the plot. Note that this refers to <u>living</u> dwarf-shrub plants only. Height should be measured from ground level. It may be necessary to disturb or part the vegetation especially where a deep thatch has formed. A measuring tape or ruler must be used.

Height Classes:

Scale	*Range*	*Descriptor*
1.	<= 5cm	i.e. up to 5cm inclusive
2.	6 - 15cm	i.e. greater than 5cm to 15cm
3.	16 - 30cm	i.e. greater than 15cm to 30cm
4.	31 - 49cm	i.e. greater than 30cm to less than 50cm
5.	50cm +	i.e. 50cm or more

This value can correspond with vegetation height in some cases.

Heathers (%)
Definition: dwarf shrubs which are classed as heathers comprise the ericaceous (family Ericaceae) species: ling heather (*Calluna vulgaris*) and *Erica sp*., the most common being bell heather (*Erica cinerea*) and cross-leaved heath (*Erica tetralix*). Crowberry (*Empetrum nigrum*) is also included as a heather, although it is not strictly ericaceous (family: Empetraceae). Other dwarf shrub species such as dwarf gorse (*Ulex galli*) and bilberry (*Vaccinium myrtillus*) are not classed as heathers and are excluded. Record the combined cover of all <u>living</u> heather species in the plot.

Heather Dieback (%)
Estimate percentage cover of heather suffering from die-back. Die-back can be associated with burning, grazing by large herbivores or with heather beetle (*Lochmaea suturalis*). Record only <u>dead</u> plants. Note: do not record bare stems of partly-leaved living plants, e.g. the degenerate growth phase of ling heather (*Calluna vulgaris*); these are included in the % cover of those living plants.

Ling Heather Growth Phase
Record the modal (most common) growth phase of ling heather (*Calluna vulgaris*). See Annex 1. for descriptors.

Calluna vulgaris Growth Phase
A. Pioneer phase
B. Building phase
C. Mature phase
D. Degenerate phase

Trees and Shrubs (%)
Estimate the total combined percentage cover of all trees and shrubs in the plot. Include over-hanging plants. Note that dwarf shrub species are not included.

Slope (°) Class
Categories are:

Scale	*Range*
0.	approximately level (ca. 0°)
1.	gentle (<10°)
2.	moderate (10° – 20°)
3.	steep (>20°)

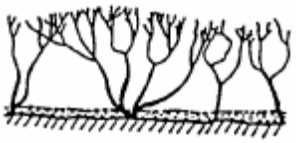
Aspect (°)
Measure the aspect in degrees by compass looking straight down the slope. Note that if the aspect is directly North this is recorded as 360°. If the slope is approximately level (ca. 0°) then the aspect is recorded as 0°.

Annex 1. Ling Heather (*Calluna vulgaris*) Growth Phase

The growth phase of ling heather (*Calluna vulgaris*) can be difficult to assess. Dwarf shrub height is also recorded to complement this variable. Note: growth phase may be affected by altitude (eg. montane) and exposure, and in bog habitats the accretion of the bog-moss surface tends to generate adventitious shoots and a dominance of vertical stems. Regeneration via layering can also occur around the periphery of plants in the degenerate phase. There are 4 main growth phases.

A. ***Pioneer phase***: In the pioneer stage (ca. 0-6 years old), heather establishes and grows vertically from the apex to form small pyramid shaped plants. The height is usually less than 10-15 cm. Short (mown, burnt or grazed) swards can be included as 'pseudo-pioneer'.

B. ***Building phase***: During the building stage (ca. 6-14 years old), the plant grows laterally and forms a dense intertwining canopy with little light penetration. It grows up to ca. 40 cm.



C. ***Mature phase***: In the mature stage (ca. 14-25 years old), lateral growth slows. The heather plants become woody, with thick stems and fewer green shoots and the plant thins out in the centre. As the heather canopy begins to open up other plant species, especially mosses, begin to increase in cover.

D. ***Degenerate phase***: In the degenerate stage (more than 25 years old), central branches tend to collapse and die off, leaving a gap in the middle of the plant. This may sometimes allow heather seedlings to establish or regeneration via layering can occur around the periphery.

References.

McCann, T., Rogers, D. and Cooper, A. (2007). Northern Ireland Countryside Survey 2007: Field methods and technical manual. *Northern Ireland Environment Agency, Research and Development Series* No. 09/07. Belfast.

The appendix has been removed under Regulation 12(5)(g) of the Environmental Information Regulations 2004. This regulation states that a public authority may refuse to supply environmental information in order to protect the environment to which it relates.

NICS2007 Quadrat Survey Manual: PART 2.

Technical methods

CONTENTS

1. QUADRAT RECORDING

1.1 Introduction

Quadrat data will be recorded onto electronic data forms with a handheld Personal Digital Assistant (PDA). In an emergency (electronic failure), paper field data sheets can be used.

1.2 Quadrat Survey Procedure

Each survey team has a global positioning system (GPS) with a copy of the 1:5000 NICS sample square land cover map 2007 (***Appendix 1***). Each parcel of land on the field map is labelled with a unique code. The parcel number is prefixed by a capital letter: W – Woodland (dark green), S - Seminatural vegetation (orange), A - Agricultural grassland/crops (light green) and L - Landscape features (grey).

A work schedule sheet will be provided for each sample square detailing the quadrat locations within each square (***Appendix 2***). This provides the NICS square coordinates (bottom left corner). Each square is 500m by 500m; therefore add 500m to the northing (Y) to get the top left corner coordinate of the square. To get the bottom right corner coordinate, add 500m to the easting (X). The work schedule also states which parcel the quadrat is within (e.g. W03 refers to woodland parcel number 3 on the map). The bottom left corner X, Y coordinate of the quadrat, the 2007 habitat type of that parcel, the PDA file name/quadrat ID and quadrat dimensions are also found on the weekly work schedule sheet.

Orientate yourself initially using a 1:50,000 Ordnance Survey paper map and compass to locate the NICS 2007 sample square. Become familiar with the layout of the topography, road/tracks and buildings. Use the 1:5000 land cover map and compass, together with the GPS if necessary, to locate the quadrat. Note the GPS may not operate in dense woodland. If so, use the land cover map, compass and measuring tape to locate the quadrat. If any measurements are made to place a quadrat then a sketch map must be drawn. This should have distances, arrows, compass bearings and should be legible and clear.

The land cover map is based on 2007 field survey, and may have changed since 2007 (the work schedule sheet provides the 2007 land cover type). If this is the case, record the new primary land cover type on the work schedule sheet, but do not record the quadrat. A replacement quadrat will be issued.

If however, the primary land cover type has not changed then setup the quadrat, record the species and Domin value electronically. Take a GPS point at the bottom left corner (BLC) of the quadrat. As you finish, check for data file for omissions and make a backup copy of the quadrat file on the SD card.

1.3 Electronic quadrat forms

1.3.1 Electronic quadrat form structure

Data is recorded electronically with a PDA. The PDA holds preloaded electronic quadrat forms. Electronic forms are displayed in a vertical format and consist of a series of text boxes and drop down menus into which you enter quadrat data. The drop down menus for species, Domin values and environment variables are already loaded onto the PDAs in the form of a data dictionary. A woodland data dictionary allows up to 50 species to be recorded within a quadrat, while a grassland or heath and bog data dictionary allow up to 35 species. If there are more than 50 species or 35 species respectively in a quadrat, then a second file has to be created using the appropriate continuation data dictionary

1.3.2 PDA electronic quadrat file names

The PDA file name of each quadrat is found on the work schedule sheet. When creating the electronic file, name it according to the work schedule sheet. The PDA file names refer to the NICS 2007 survey square and the land cover parcel in which it is located, e.g. **A012_W01a** (refers to Antrim sample square number 012 and states that the quadrat is within woodland parcel W1). When there is more than one quadrat in the same land cover parcel (e.g. W1), they are named accordingly, e.g. **A012_W01a**, **A012_W01b** etc. The work schedule sheet also gives PDA Quadrat ID which is the same as the PDA file name (e.g. **A012_W01a**). All PDA file names and quadrat IDs must correspond with those on the work schedule sheet, therefore always refer to this when creating and naming files. Each quadrat is recorded by creating an individual electronic file.

If there are more than 50 species in a woodland quadrat or more than 35 species in a grassland or heath and bog quadrat, then a second file is needed using a continuation data dictionary, then name the second file the same as the first but followed by _**cont.** (e.g. **A012_W01a_cont**.).

1.3.3 Species codes

Species have a binomial latin name in the PDA data dictionary. The main species appear in drop down menus. The binomials in the drop down menus are in alphabetical order. Each tree species is duplicated 3 times in the drop down menu (based on their height) so you can record trees <1.3m, trees 1.3m – 5m and trees >5m. Any species not in the drop down menu should be written into text boxes at the bottom of the quadrat form.

1.3.4 Writing queries

Queries or notes about quadrats are recorded in an electronic query box at the bottom of the quadrat form (or on an emergency paper query form). Queries will be answered by the project co-ordinator. Keep queries short because there are only 100 characters in the electronic text box.

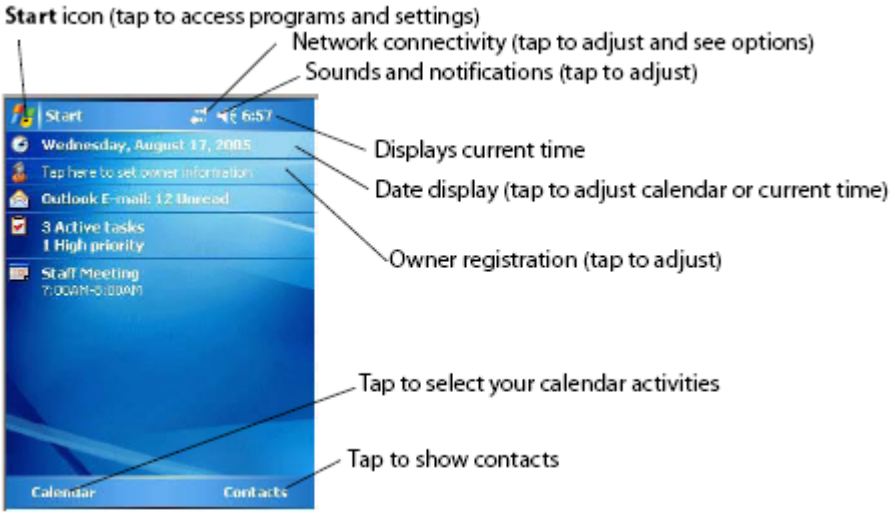
1.4 Electronic Data Capture - Overview

In order to record data electronically using a PDA, you must become familiar with the operating system, i.e., Windows Mobile 5.0. The interface for electronic data forms is Trimble TerraSync software. Guidance on the use of these packages follows. Trimble GeoExplorer XM handheld PDAs will be used to capture quadrat data. This PDA has an integrated Global Position System (GPS). A Trimble GeoExplorer XM general user guide is detailed in ***Appendix 3***. A Trimble recon may also be used as emergency PDA but has no GPS. A Trimble Recon user guide is detailed in ***Appendix 4***.

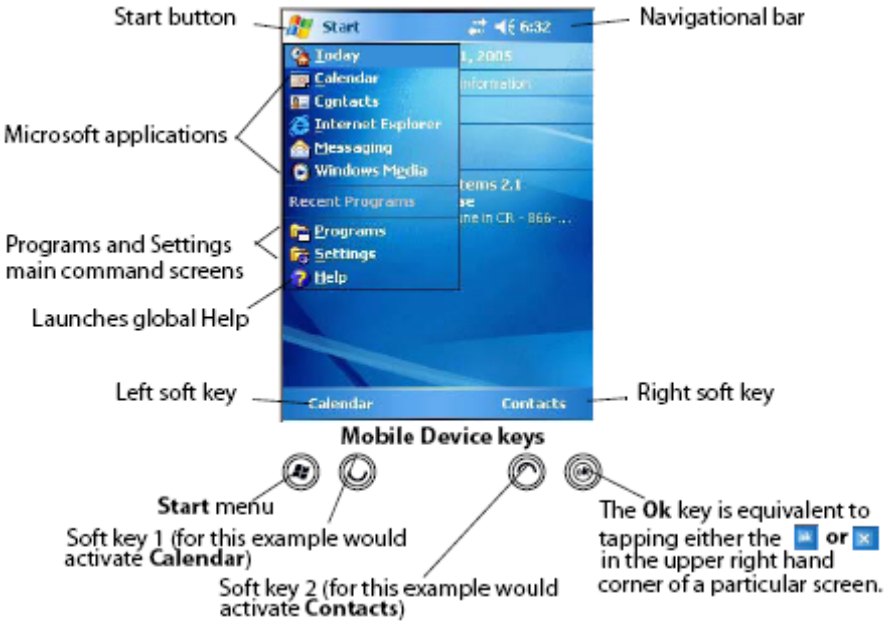
2. INTRODUCTION TO THE PDA - WINDOWS MOBILE 5.0 USER GUIDE

2.1 Today screen

Turning on your PDA the first time brings up the **Today** screen. Tap the **Start** icon to access programs and settings. TerraSync is used for recording field data.



To open a program shown on your **Today** screen, tap the button. You can switch from one program to another by selecting it from the **Start** menu.



The buttons below the display activate the on-screen soft keys. Soft keys are the default set by individual applications. The key on the left side corresponds to the left option and the key on the right corresponds to the right option in any particular screen. These keys assist in operating the device without using a stylus.

2.2 Using the Stylus

The touch screen on your PDA works like a mouse on a PC. Use the stylus to navigate and select objects on the screen.

Tap: Tap the screen with the stylus to select or open an item. Tapping is equivalent to clicking an item with the mouse on a PC.

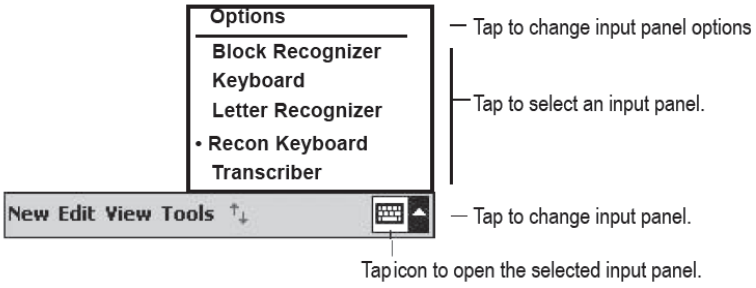
Touch and hold: When you touch and hold, a circle of red dots appears around the stylus to indicate that a pop-up menu will soon appear. Touching and holding is equivalent to right-clicking your PC mouse button.

Drag: Hold the stylus on the screen and drag across the screen to select text and images. Drag in a list to select multiple items.

2.3 Entering text

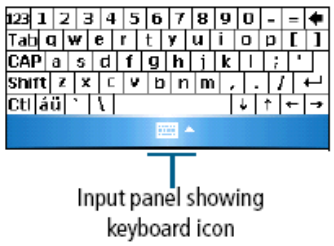
The handheld does not have a physical keyboard. To enter text, use the on-screen keyboard. This is normally how you would enter field data. Alternatively, you can write directly onto the screen. You can select how you want to enter text using the Input Panel. The Input Panel automatically appears in the menu bar of any application. The default selection is the on-screen keyboard. To change the text input method (first open an application e.g. tap **Start** > **Programs** > **Notes**)

- In the menu bar (blue bar at bottom of screen), tap the arrow on the **Input Panel** button. (You may have to activate and then hide the keyboard for the arrow to appear.) A list of input methods pops up. The currently selected method is indicated by a check mark.
- Tap the method you want to use to select it. You can write using Onscreen Keyboard, Block Recognizer, Letter Recognizer, or Transcriber. The characters appear as typed text on the screen. The on-screen keyboard is the easiest input panel to use.



2.4 Using the on-screen keyboard

Tap **Start** > **Programs** > **Notes** (bottom left soft key) > **New** to open Notepad. To activate the on-screen keyboard, tap the keyboard icon on the Input Panel displayed in the menu bar. The on-screen keyboard appears. To enter text, tap the appropriate keys on the on-screen keyboard. When you have finished entering text change the input panel and test which is most suitable for you. The on-screen keyboard is probably the easiest option.



Note: A tap on the “Shift key allows you to use the “%” and “_” keys.

2.5 Accessing help

To access help, tap / *Help* or, if available, *tap* in the application window. If there is an application running, context-sensitive help for the current screen appears. To view the main Help Contents page, tap the *Contents* soft key in the menu bar. Help files installed on the handheld work in the same way as a Web page. Tap hyperlinks to navigate around the help and use to retrace your steps.

2.6 Caution

Windows Mobile Version 5.0 software does not include a Recycle Bin. If you delete files from the flash disk, they are deleted permanently therefore if in doubt, do not delete.

3. PDA - TERRASYNC SOFTWARE USER GUIDE

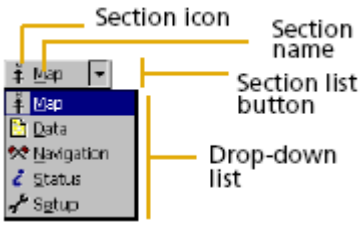
3.1 About TerraSync Software

The TerraSync software is designed for recording (collecting) field data, GPS points and for navigation.

3.2 Introduction

Open TerraSync by tapping **Start** and then tapping **Terrasync** from the popup menu. The TerraSync software is arranged in the following five sections:

- Map section
- Data section
- Navigation section
- Status section
- Setup section



One of these sections is always active and visible. The Section list button shows the section that is currently active. You can move between sections at any time (e.g. to look at a map, record data or to navigate) without closing any open data forms you are recording on. To switch to a different section, tap the Section list button and then select the section you want from the drop-down list. For example, to switch from the Map section to the Data section, tap the **Section list** button and then select **Data**. The button now shows **Data**, and the Data section is active. When you return to the Map section, the screen or form that was open when you left the Map section appears again.

3.3 Sections

The TerraSync software sections are used as follows:

3.3.1 *Map* section – to display an OSNI line map of the sample square showing quadrat locations. It can be displayed in the background for reference. The map section is used as a navigational aid to locate the quadrat within a NICS survey square or if you get lost.

3.3.2 *Navigation* section – to navigate to specific locations, you use real-time differential GPS.

3.3.3 *Data* section – you record/collect field data onto forms here and record/collect GPS positions

3.3.4 *Setup* section – systems will already be setup for NICS quadrats prior to you starting work. However it is necessary to explain some of the setup options in the event that any of the systems need to be reset at any stage.

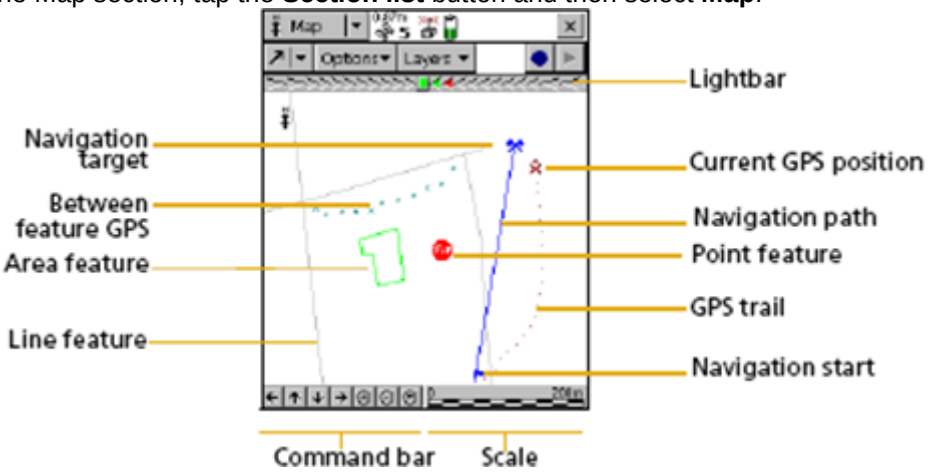
3.3.5 *Status* section – used to view summary or detailed information about the software, the GPS receiver and the location and health of the satellites the receiver is tracking. This section is relevant for taking GPS points for quadrats - the status section gives an indication of how accurate the GPS is at a particular moment in time.

A summary quick-start user guide to TerraSync software is given in ***Appendix 5***.

3.4 Map Section

3.4.1 Elements and controls in the Map section

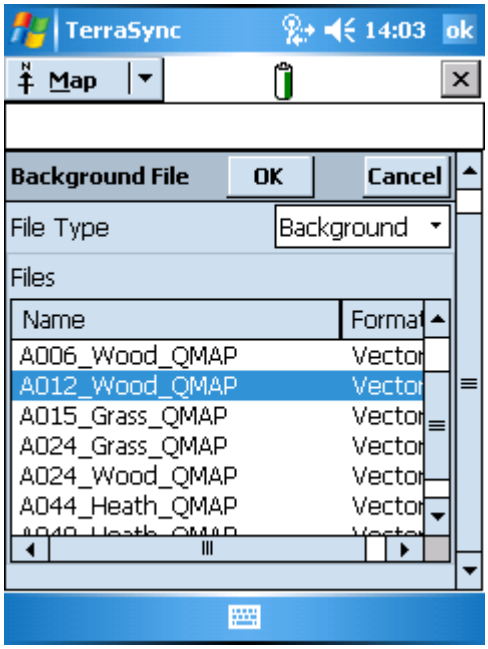
To open the Map section, tap the **Section list** button and then select **Map**.



3.4.2 Map layers

There is an OSNI vector line map of each survey square with quadrat locations (known as a map layer or background file) available to you. The map layers needed for the quadrats you will be recording will be preloaded onto your handheld each week. The map files are named according to their area of ecological study (AOES), square number and quadrat survey (e.g. A012_Wood_QMAP refers to Antrim sample square 012 woodland quadrats.

To open a *Background File*, in the Map section tap **Layers** and then select **Background file**. For file type, select **Background** from the drop down menu and a list of the available backgrounds are shown. From this list **highlight** the quadrat map (e.g. **A012_Wood_QMAP**) of your study area and click **OK**. This map should now be displayed with quadrats shown as blue squares with a red X highlighting the bottom left corner (BLC). If not, hit the full extent button as described in section 3.4.3. It is also now possible to zoom, pan and measure anything on the map using the map tools (section 3.4.3). Points captured by GPS can also be displayed in the background and these will appear as green Xs once captured.

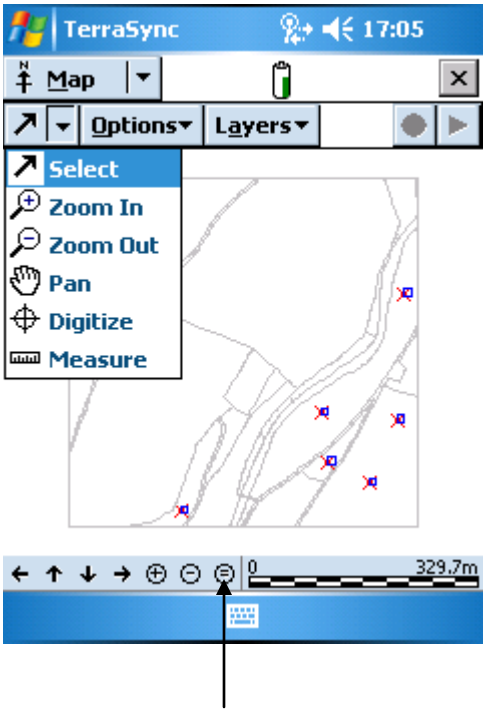


Any data file in the TerraSync software can be selected as the background file, provided it is not already open in the Data section i.e. provided you are not using it as a recording form. When you open a data file in the background, its features are visible but cannot be selected, edited, or deleted. Do not edit any background layer files. They should be used for navigational purposes only.

If the GPS is switched on (Section 3.7.2 explains how to connect to the GPS), a cross hair will appear indicating your position (this is useful when navigating to the square). If you tap **Layers > GPS Trail**, this will create a trail of your recent movements within the square. The GPS has to be connected to allow a cross hair or trail to be viewed.

3.4.3 Map tools

The Map section has six map tools (available in the drop down menu just below **Map**). Only one map tool is active at a time. To change to a different map tool, tap the Map Tools button and from the drop-down list select the tool you want to use. The tools allow you to select, zoom in, zoom out, pan, digitize and measure.



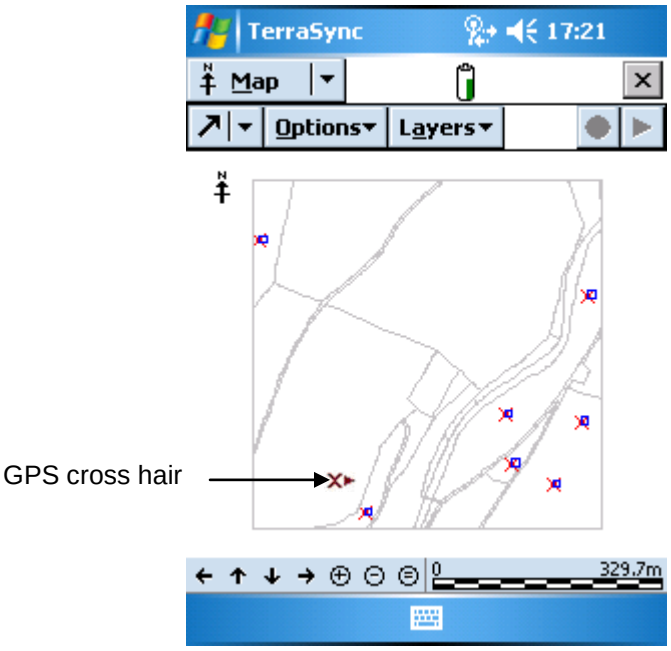
An additional series of tools are also found at the bottom of the map screen (move left, move up, move down, move right, zoom in, zoom out and full extent). If a background map does not appear when added, then tap the full extent button. The map should appear.

3.5 Navigation section

There are two main ways in which TerraSync can be used to navigate to a quadrat. For both, the PDA has to be connected to the GPS (**Setup > Options > Connect to GPS**). More details on connecting to the GPS are described in section 3.7.2. It will not always be possible to use GPS to navigate to quadrats that are located in woodland where a dense canopy can weaken and restrict a signal. In such cases quadrats are located using the 1:5000 scale 2007 land cover map with a compass and measuring tape.

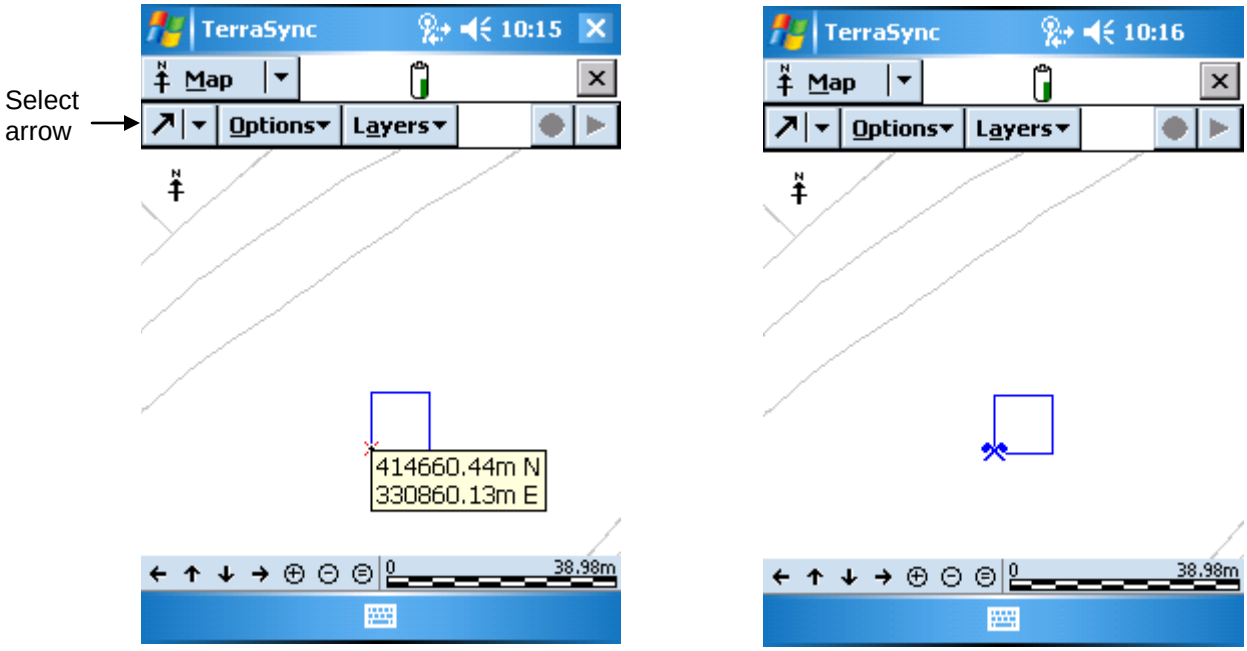
3.5.1 Using Map to locate quadrat

With a background map of NICS survey square loaded, as described in section 3.4.2, it is possible to navigate to the desired quadrat. When connected to the GPS a red cross hair will appear indicating your position as shown below. The cross hair moves in real time with your movement while the header on the cross hair points towards the direction in which you are moving. Keep walking until the GPS cross hair is directly over the quadrat bottom left corner (BLC) indicated by the red X. You may need to zoom in to ensure this is the case. When the GPS cross hair is directly over the red X, insert the BLC pole of the quadrat here.

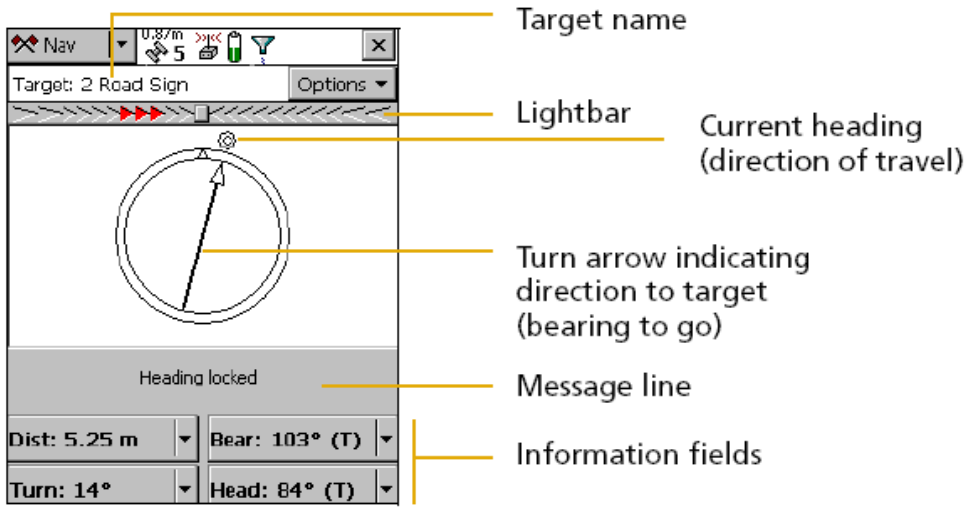


3.5.2 Using Navigation tool to locate quadrat

An alternative approach is to use the navigation tool, which may prove useful in upland squares where there are less boundaries and it is more difficult to orientate yourself. Firstly a target must be set in the Map section. To do this, zoom in to the target quadrat, then select the arrow in the top left corner of the screen and tap on top of the BLC of the target quadrat (red X). The northing and easting will appear onscreen in a light coloured box and should correspond with the coordinates on the work schedule sheet. If not, zoom in and tap again making sure the arrow is selected in the top left corner of the screen when tapping a position. Then click **Options > Set Nav Target > Map Point**. The target icon will appear.

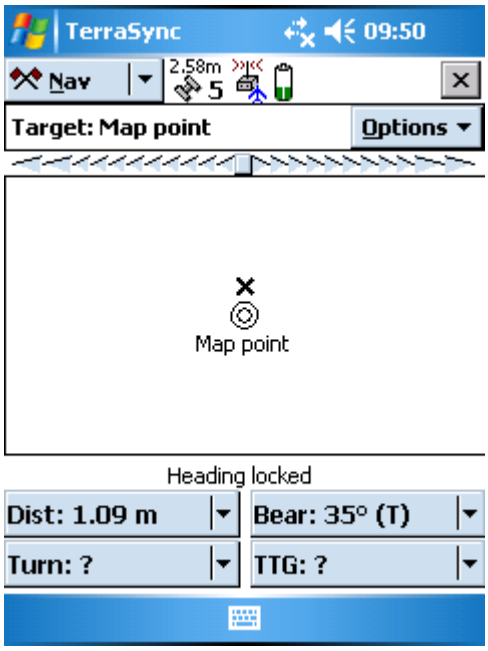


Now that the target has been set, tap the **section list** and select **Navigation**. Use the information displayed on the direction dial screen to navigate to the target quadrat.



This screen displays all the information that you need to navigate to the target quadrat. The information fields at the bottom of the screen display different types of navigational information. To navigate to the selected target, start moving. This enables the TerraSync software to calculate your initial heading. When the direction dial shows the turn arrow, keep moving and turning until the arrow points to the top of the screen. The top of the screen indicates your current heading. Then move towards the target, adjusting your direction to ensure you are always heading toward the target.

When you are within 5 metres of the target quadrat, TerraSync starts beeping and the view switches to a close up screen of the target. You have reached the position when the GPS cross hair is over the top of the bulls eye symbol.



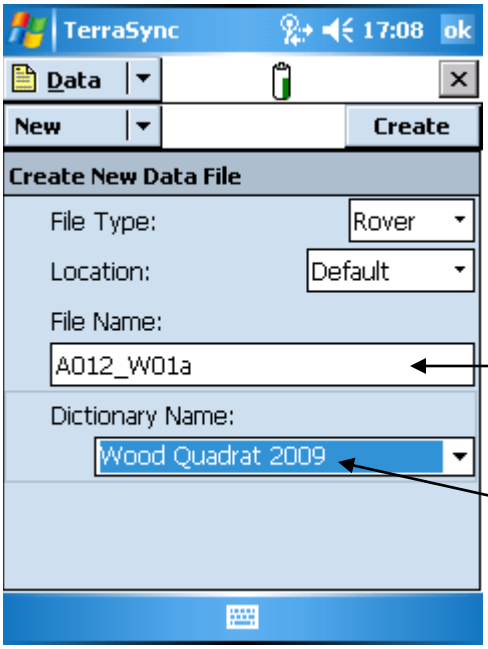
To clear a Navigation target, in the section list tap **Map > Options > Clear Nav Target**.

3.6 Data Section

3.6.1 Recording NICS quadrat species data

The Data section is used to record quadrat information and capture a GPS point at the bottom left corner of each quadrat. You will be provided with data dictionaries containing the field data forms onto which you record. Each PDA is loaded with 9 data dictionaries. There are 3 primary species data dictionaries for species recording called **Grass Quadrat 2009**, **Heath bog Quadrat 2009** and **Wood Quadrat 2009** and 3 secondary species data dictionaries called **Grass Quadrat 2009 cont**, **Heath bog Quadrat 2009 cont** and **Wood Quadrat 2009 cont**. The secondary species data dictionaries are only continuation dictionaries and should only be used if there are more than 50 species in a woodland quadrat or more than 35 species in a grassland or heath and bog quadrat. Finally there are 3 environment data dictionaries called **Grass Env 2009**, **Heath bog Env 2009** and **Wood Env 2009**. These are used to record environmental variables within each quadrat.

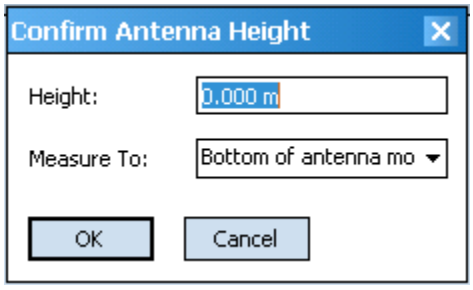
In the Data section, select **New**. Select **Rover** as file Type, and type the unique PDA file name as the file name e.g. **A012_W01a**. PDA file names for each quadrat location are found on the work schedule sheet. Always refer to the work schedule sheet when creating new electronic quadrat forms. Select the appropriate data dictionary under Dictionary Name. Then click **Create**, this sets up the form structure that allows you to record field data.



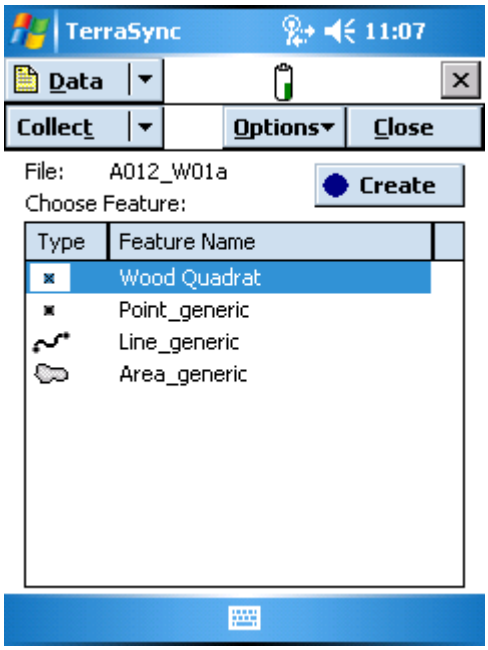
Type Quadrat Code e.g. **A012_W01a**

Select data dictionary i.e. **Grass Quadrats 2009** Or **Heath bog Quadrats 2009** Or **Wood Quadrats 2009**

A message asking to confirm antenna height appears. This is to ensure accurate measurement of altitude. In this case this is irrelevant, hence just tap **OK**. When tapping create, the confirm antenna message will not appear immediately so be patient.



Once **OK** has been hit you will see the following screen. The quadrat species data dictionaries are quite large and may take about 1 minute to load hence be patient and allow the PDA time to open the data dictionary. Continued tapping on the screen will result in the PDA crashing at which point you will have to hold down the PDA power button for 5 seconds to reset the PDA. Provided you are patient, the PDA will always open the data dictionary within 2 minutes.

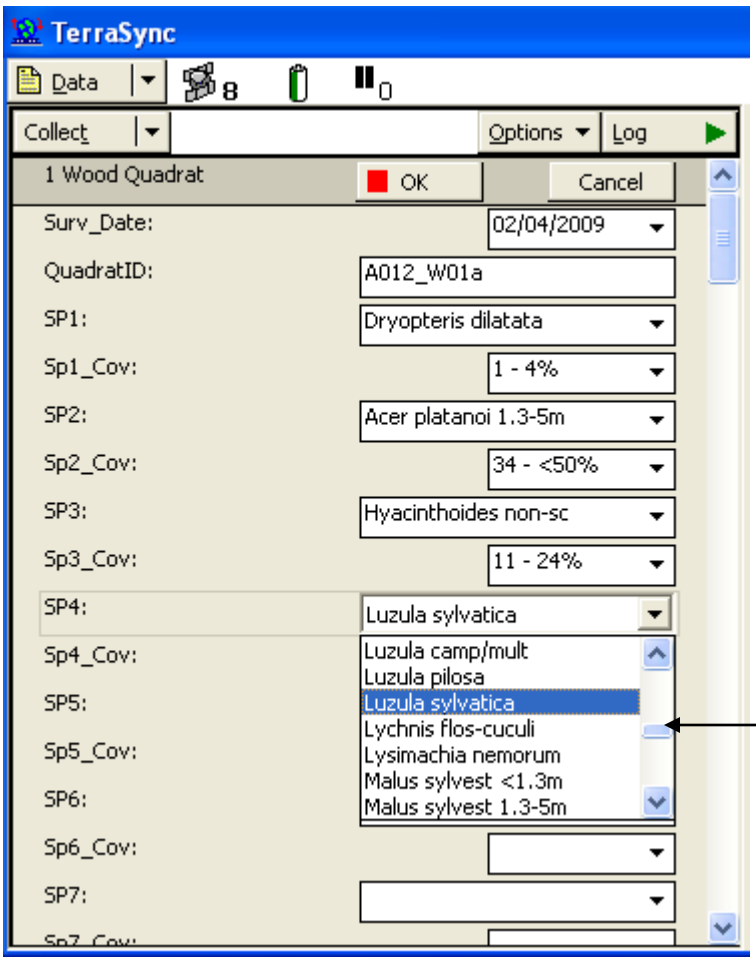


Four feature names are shown. **Quadrat** is the feature which is required. Ignore Point_generic, Line_generic and Area_generic. These are created by default and are not to be used to record quadrat data.

To record a quadrat, either double click **Quadrat** under the **Feature name list** or highlight **Quadrat** (one click) and then click **Create**. This brings up the quadrat species recording form as shown overleaf. Again be patient and allow the PDA time to open the form. Impatient tapping of the screen will cause the PDA to crash. When creating a new data entry form, **Collect** is selected in the top left corner. If you wanted to edit an existing quadrat record, you would change this to **Update**.

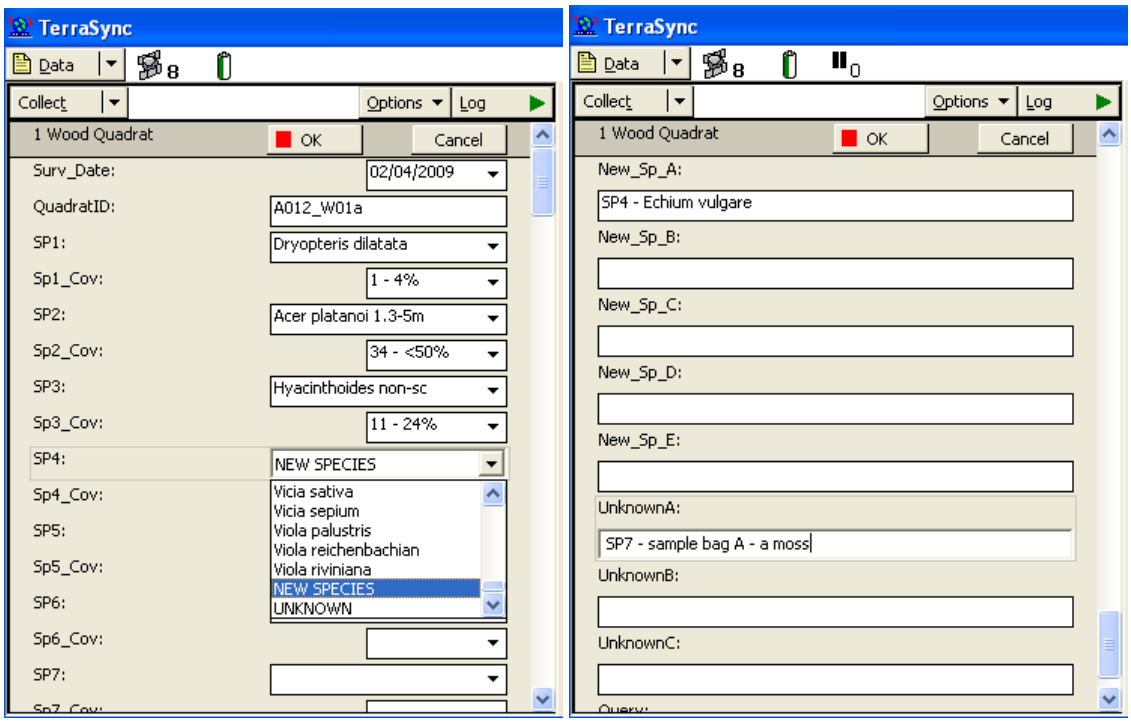
The species quadrat form is structured using text-boxes and drop-down menus. The drop-down menus contain the options available to you from which to choose. The species list in the drop down menu is quite long. You can speed scroll down the long drop-down menus using the scroll bar at the side. Alternatively if you tap on a drop-down menu and then tap a letter (e.g., L) on your on-screen keyboard, the drop-down menu will automatically display those species names beginning with the letter L. The botanical names of the species in the drop down menus are in alphabetical order.

Survey date is generated automatically. A quadrat ID is used to identify the quadrat. The quadrat ID is found on the work schedule sheet. It is important the Quadrat ID is recorded electronically precisely as it is on the sheet. The Quadrat ID will be the same as the PDA file name. Quadrat ID is a required field and has to be entered first otherwise the software will not allow you to continue. Remember, text is entered using the input panel located on the bottom menu bar.



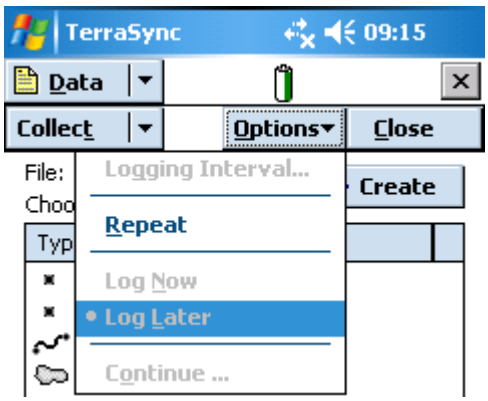
If the drop down species list does not contain the species you want, select “NEW SPECIES” in the drop down species menu (this is found at the bottom of all the species lists). With “NEW SPECIES” selected, (as shown in the screenshot overleaf), you specify the species name in the dummy text box ***New_Sp_A*** at the bottom of the form. Type in the PDA species number, for example if it refers to PDA Sp4 then type Sp4 followed by the species botanical name (see screenshot overleaf). If the new species is a tree, make sure to record its height i.e <1.3m, 1.3m – 5m or >5m. Record the domin value as normal in the appropriate domin drop down menu, in this case, in *Sp4_cov*. If there is more than one new species use the additional new species text boxes ***New_Sp_B***, ***New_Sp_C*** etc. The majority of the species you will encounter will appear in the drop down species list. Any frequently reoccurring new species recorded by field surveyors will be added to an updated data dictionary as the field work progresses.

If you are unable to identify a species, bag it and bring it back to the lab for identification. The quadrat form contains an “UNKNOWN” option at the bottom of the species drop down menu (see overleaf). Make sure you select “UNKNOWN” if the species can not be identified. Likewise label the bagged species with quadrat ID and PDA species number. Type in a comment in the text box labeled “**UnknownA**”. Record the domin value as normal in the appropriate Sp_cov drop down menu. If there is more than one unknown species use the additional unknown text boxes **UnknownB**, **UnknownC** etc. Make any additional queries or notes about a quadrat, into the query box. The project staff will confirm i.d. of any unknown species back in the lab. Once identified, update the PDA file if not already downloaded (section 3.6.4 gives details on updating a record). If the PDA has already been downloaded, edit the quadrat data paper printout.

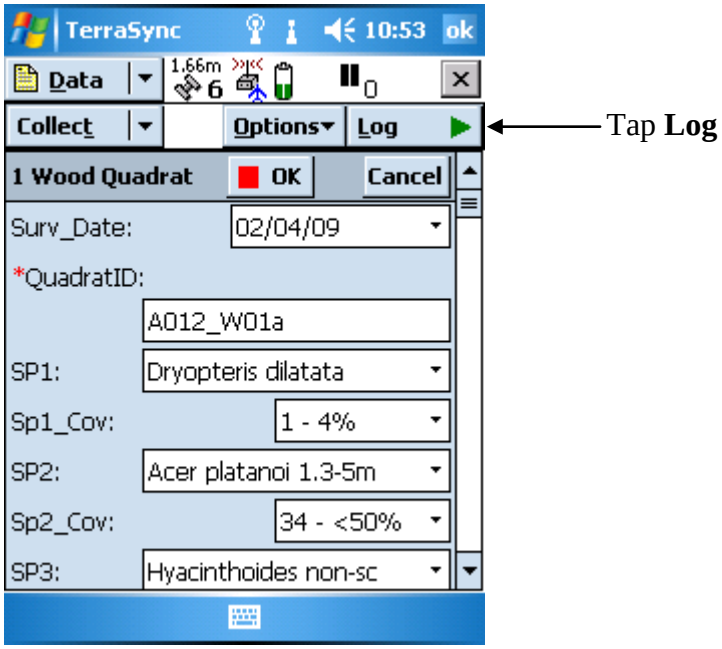


When finished recording species data, double check to make sure the data form is complete, e.g., make sure that all cover value boxes are filled and that unknown and new species are coded. Note that when you put data into a box, you automatically jump to the next field thus facilitating recording. It is easy to record a species you did not mean to record when using the species dictionary. Check that you do not record the wrong species.

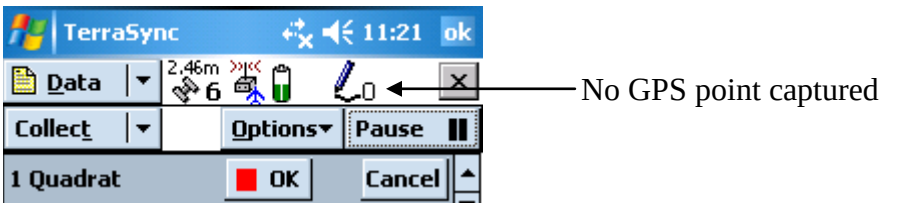
When all species and domin values have been recorded for a quadrat, you must capture a GPS point at the bottom left corner of the quadrat. The GPS must be connected before you can do this, **Setup > Options > Connect to GPS**. More details on connecting to GPS are described in section 3.7.2. In the Data Collect form, tap **Options** and check if **Log Later** is checked as below, (this is normally default).

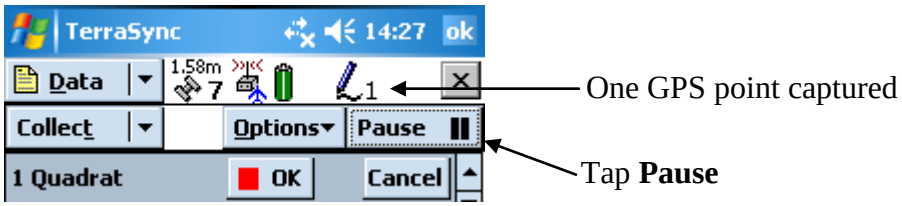


Move to the bottom left corner of the quadrat and while receiving a GPS signal tap the **Log** button.



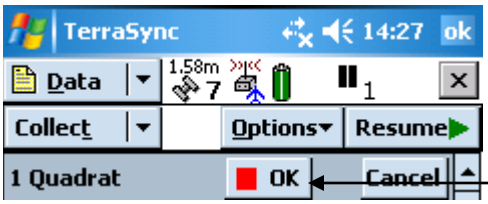
The system is set up to capture a point every 10 seconds. After **Log** has been tapped, the pencil on the top toolbar should change from "**0**" to "**1**". Once it has changed from 0 to 1, this means a point has successfully been captured



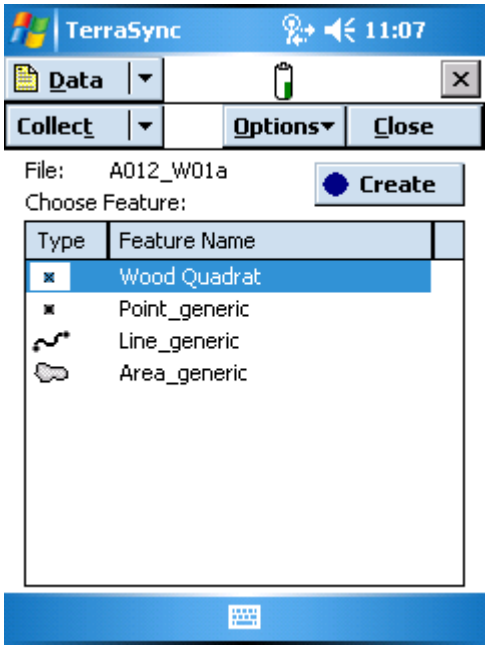


Once 1 point has been captured hit the **Pause** button. Do not capture more than one point as averages the GPS positions.

Once the GPS is paused, hit the red **OK** button to save the quadrat.



This returns to the following screen. Tap **Close** to finish

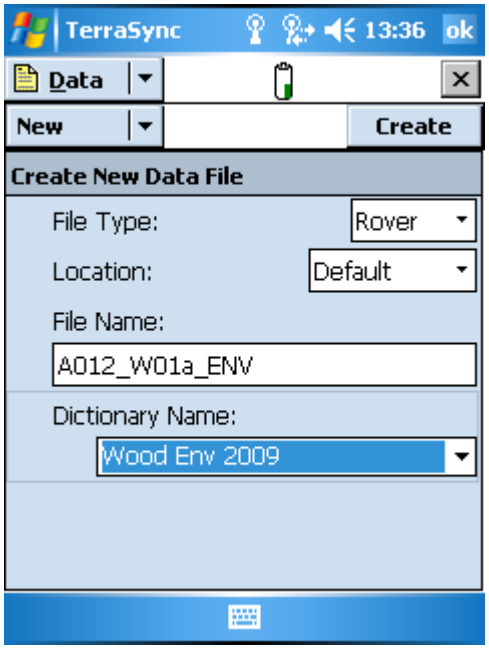


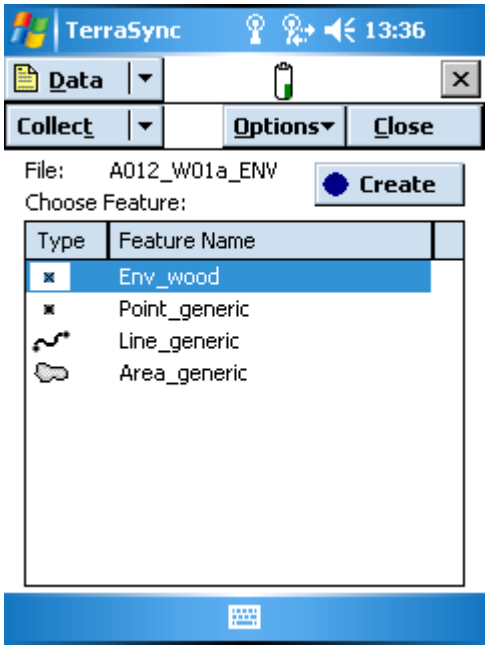
If however, the number of species in the quadrat exceeds that allowed in the data dictionary, then create a second additional file using the appropriate continuation data dictionary. Do this as before, **Data > New > Insert file name** (same as before only add **_cont.** to the end to indicate that this is a continuation file i.e. **A012_W01a_cont.**) **> Choose continuation data dictionary** (e.g. **Wood Quadrat 2009 cont.) > Create**. Enter species as before. Quadrat ID remains the same as before. Woodland continuation data dictionaries start with species number 51 while grassland and heath and bog continuation data dictionaries start with species number 36.

3.6.2 Recording NICS quadrat environment data

Once the species have all been recorded, proceed to record the environmental variables for the quadrat by creating a new file using the appropriate environmental data dictionary - **Grass Env 2009**, **Heath bog Env 2009** or **Wood Env 2009**.

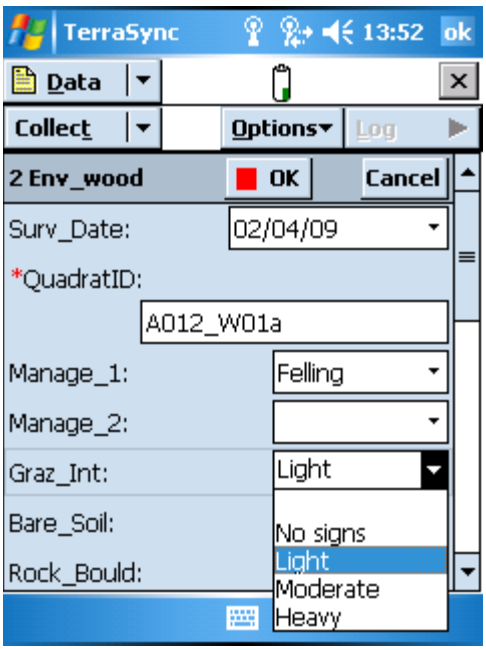
Tap **Data > New > Insert file name** (same as Species file name, only add **_ENV** to the end to indicate that this is an environment file i.e. **A012_W01a_ENV > Choose environment data dictionary** (e.g. **Wood Env 2009**) **> Create**.





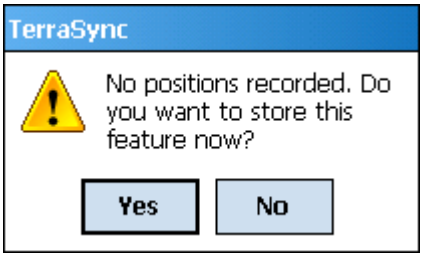
Four feature names are shown. **Env** is the feature which is required. Ignore Point_generic, Line_generic and Area_generic. These are created by default and are not to be used to record quadrat data.

To record an environment file, either double click **Env** under the **Feature name list** or highlight **Env** (one click) and then click **Create**. This brings up the quadrat environment recording form as shown overleaf. When creating a new data entry form, **Collect** is selected in the top left corner. If you wanted to edit an existing quadrat environment record, you would change this to **Update**.



Enter the quadrat ID (which is found on the work schedule sheet). Quadrat ID remains the same for species and environment files. Any variables which are not applicable leave blank. A GPS point at the bottom left corner is not necessary in the environment file. Only take a GPS point at bottom left corner if you forgot to record GPS point in species file. When finished recording environment data, double check to make sure all applicable variables have been recorded.

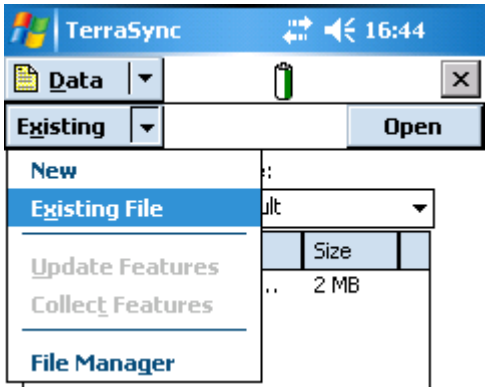
When the electronic form is complete, click **OK** as before (the red button at the top of the form). You will be confronted with the following message. It just refers to the GPS. As no GPS points are necessary as one has already been captured in the species file, just tap **Yes** to store the feature attributes. Note that tapping **No** results in the recorded data not being saved. If a GPS point is captured then this message will not appear.



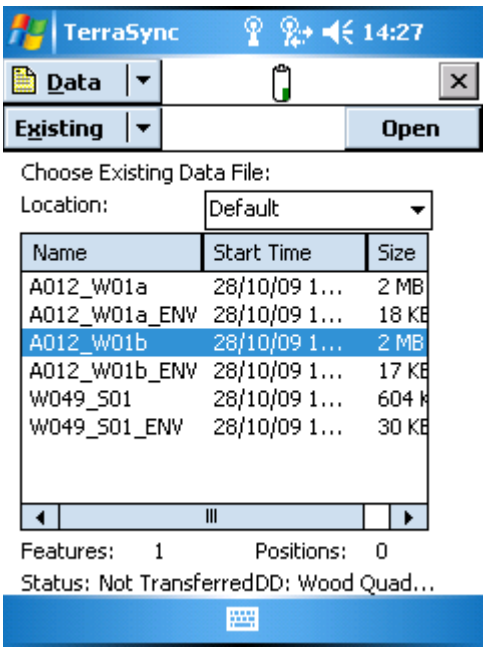
Tapping **OK** returns to the Collect feature screen. Tap **Close** to finish

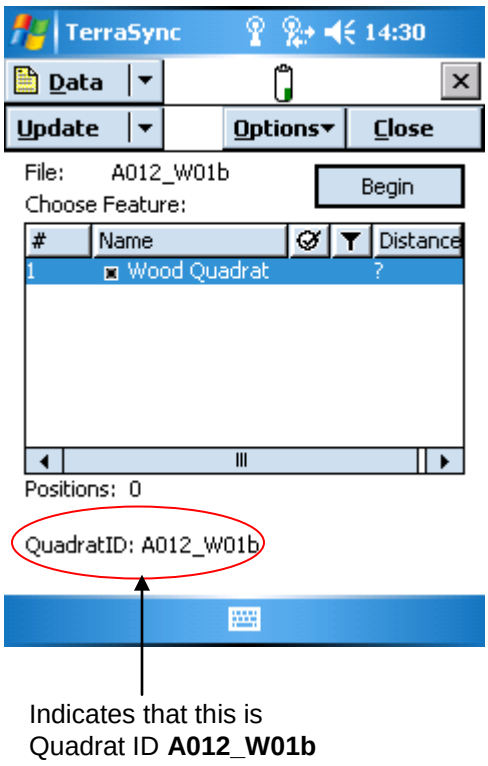
3.6.3 Open an existing quadrat file

If you need to re-open a previously recorded quadrat file i.e. to update a now identified previously recorded unknown species. Restart TerraSync by tapping **Start** and then tapping **Terrasync** from the popup menu. Select **Data** and then select **Existing File** from the drop down menu. Note existing file will not be available if you already have a data entry form open – once you close any open form (tap **Close** button), only then will **Existing file** become available.



A screen showing a list of PDA file names for each recorded quadrat will appear. Highlight the one you want and then click **Open**. Again when asked to confirm antenna height, just click **OK**. This brings up the quadrat recorded within that specific file. One quadrat is recorded within each file.

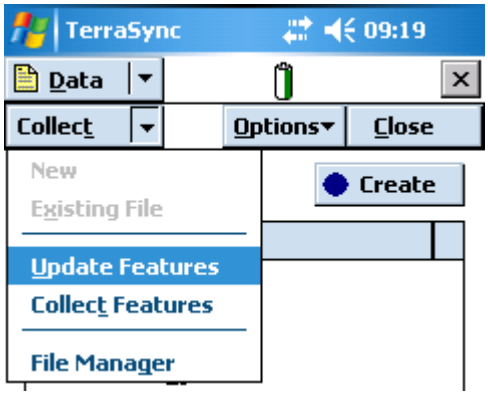




To open a quadrat record, just highlight it on the list and hit **Begin** and the form will appear.

3.6.4 Updating existing records

If you want to view or edit a previously recorded quadrat, open the existing file as described in section 3.6.3 and return to the features name list. Then change **Collect** to **Update Features** in top left hand corner. This opens the previously recorded form to which you can make edits. Once finished, click **OK** to save your edits.



3.6.5 Ending the data collection session

When the data collection session is complete, close the data file and exit the TerraSync software. To close the open data file:

- Tap **Close** in the *Collect Features* screen. A message appears, asking you to confirm that you want to close the open file.
- Tap **Yes** to close the current data file and return to the *New File* screen.

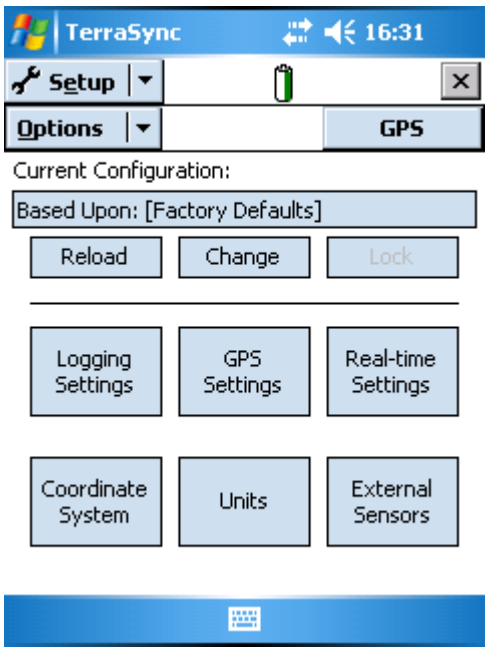
To exit the Terrasync software:

- Tap the Close button ✕ in the upper right corner of the screen. A message appears, asking you to confirm that you want to exit the TerraSync software.
- Tap **Yes** to exit the TerraSync software.

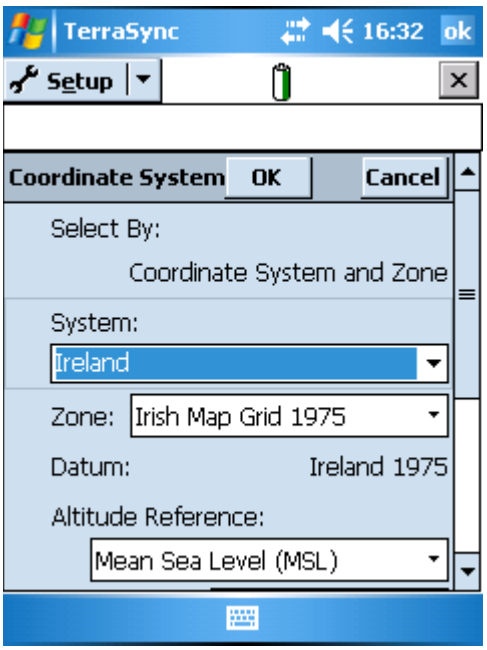
3.7 Setup Section

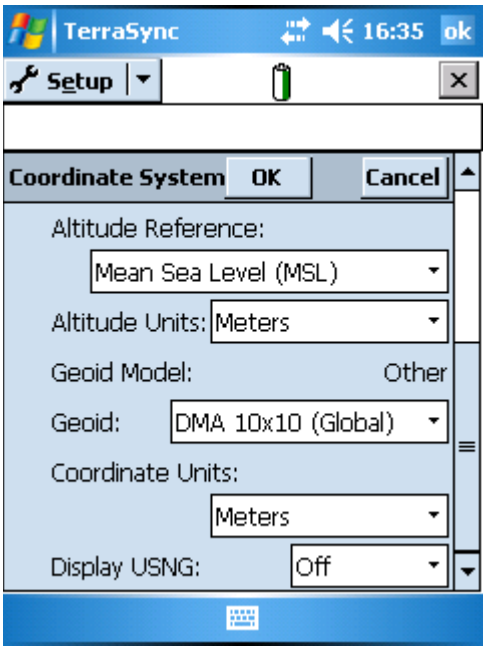
3.7.1 Setting Coordinate System

The Geo XM handheld is already referenced to the Irish National Grid. If however the Geo XM is reset at any stage, here follows a description of how to change coordinate systems. At the beginning of each day of field work before taking any GPS points it is a good idea to check if the Geo XM is actually set to Irish National Grid. In the top left hand corner of the screen, select **Setup**. The setup screen appears as follows.



Click **Coordinate System** and a screen similar to below appears.

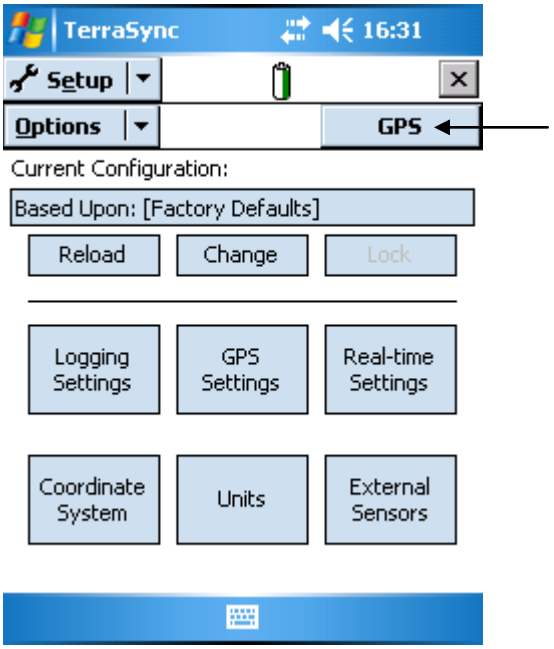




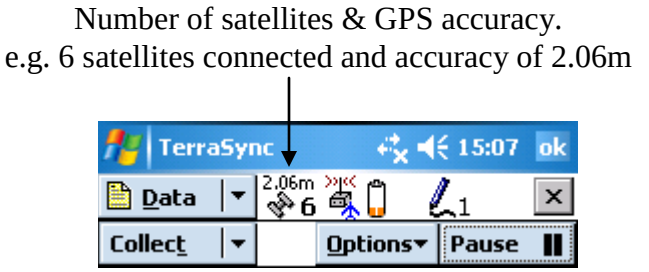
Under system select **Ireland** and under Zone select **Irish Map Grid 1975** and under coordinate units select **metres** then hit **OK**. This sets the coordinate system to Irish National Grid.

3.7.2 Connecting to the GPS

To connect to the GPS tap **Setup > Options > Connect to GPS**, or just hit the GPS button as shown below. It may take a few minutes for the GPS to connect to the required number of satellites. Refer to section 3.8 for more information on GPS signals.



When connected to the GPS, the toolbar at the top of the screen should indicate the number of satellites currently being tracked. At least 4 are needed to receive a GPS position. The GPS accuracy is also displayed. This is usually between 1 and 3 metres but can be more depending on the strength of the satellites.



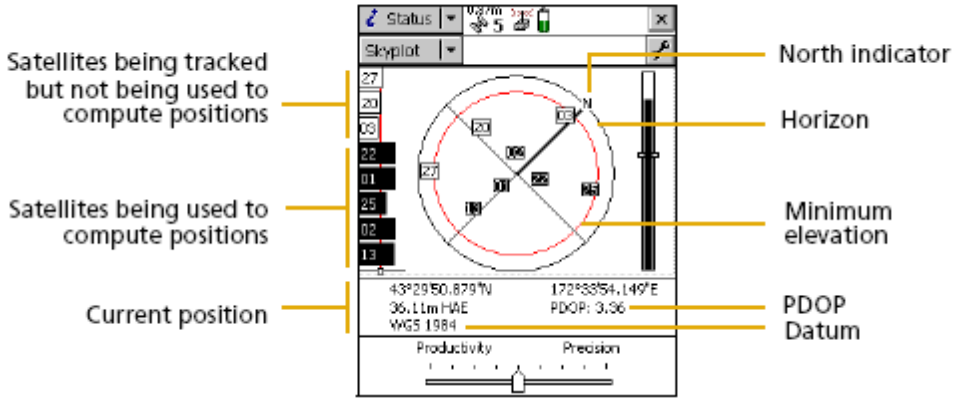
3.7.3 Disconnecting from the GPS

To disconnect from the GPS tap **Setup > Options > Disconnect from GPS**, or just hit the GPS button again.

3.8 Status Section

3.8.1 Skyplot

Use the Skyplot screen to view a graphical display of the satellites available to the receiver. The Skyplot screen is the default screen displayed when you open the Status section (top left hand corner). To access the Skyplot screen when another screen in the **Status** section is visible, tap the arrow on the Subsection button and from the drop-down list select **Skyplot.** When you turn on the receiver (**Setup > Options > Connect to GPS**), it begins to track visible satellites and to calculate the current position. Once the first position is displayed, subsequent positions are updated once per second.



3.8.2 SNR graph

The Signal-to-Noise Ratio (SNR) bar graph to the left of the skyplot is a graphical representation of the L1 frequency signal quality of each satellite that the GPS receiver is currently tracking. A black bar represents a satellite with signal strength above the configured minimum level. An empty bar represents a satellite that is not being used to compute GPS positions because its signal strength is below the configured minimum level. The more black bars mean greater accuracy of position. The black filled boxes in the Skyplot show the satellites currently being used to calculate the position.

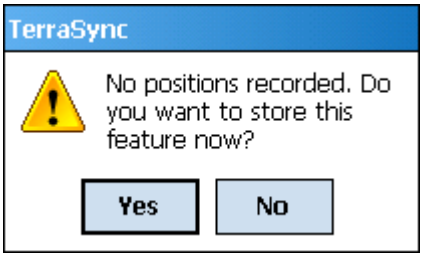
3.8.3 Message line

The message line is displayed midway down the Skyplot screen, below the skyplot. The message line displays error or warning messages. Messages only appear when there is a problem or a condition you should be aware of. For example, if satellite geometry is good, no message appears; when it is poor, a message appears. “Too few satellites” appears as a message when the GPS receiver is not tracking enough satellites to compute a GPS position. The current position - a northing and easting six figure Irish national grid reference is also displayed just below the Skyplot and should be useful in locating a quadrat. If there are too few satellites or signal strength is poor, take a 5 minute break and try again. Do not give up on first attempt.

3.8.4 GPS in woodland

Satellite signals can be blocked by buildings and dense tree cover. As a result it may not be possible to use GPS to navigate to and indeed capture a GPS point at the bottom left corner of a woodland quadrat. In saying this, GPS signals can go through leaves although they somewhat weaken the signal, therefore you should always at least attempt to receive a GPS signal and record a GPS point in woodland. If however the canopy is very dense and no satellite signal is being received, navigate to the quadrat as best as possible using a compass, a measuring tape and the provided land cover map. Store the electronic quadrat data without a GPS point. Make a sketch of quadrat location on the provided NICS quadrat location map 2009 sheet (see ***Appendix 6***) detailing compass bearings and distances.

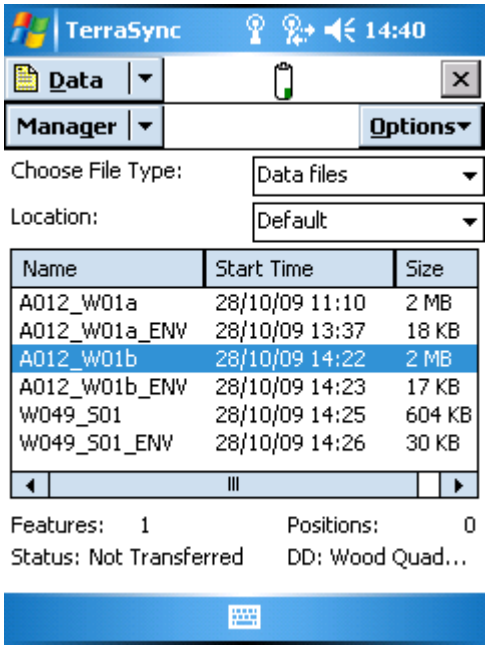
When the electronic form is complete, click **OK** as before (the red button at the top of the form). If no GPS signal has been received you will be confronted with the following message. It just refers to the GPS. As no GPS points can be recorded as no signal is being received, just tap **Yes** to store the feature attributes. Note that tapping **No** results in the recorded data not being saved, therefore always tap **Yes**. However if a GPS signal has been received and a GPS point captured then this message will not appear.



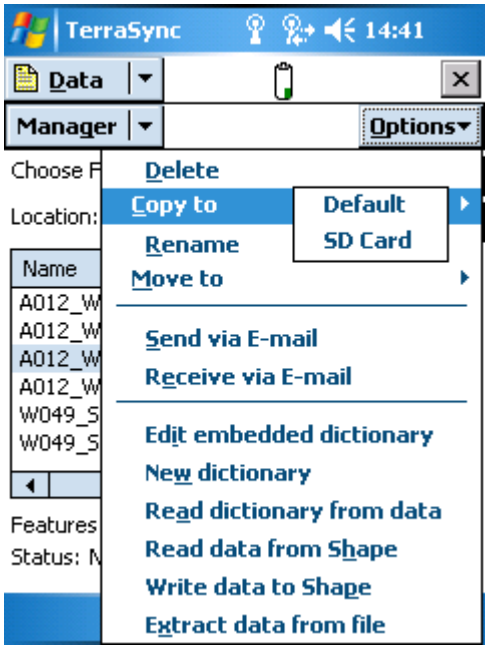
3.9 Backing up data to SD card

Each quadrat is saved when you tap the red **OK** button on the quadrat recording form. This automatically saves to the default drive on the PDA (*i.e. My Device/My documents/TerraSync*). As each quadrat is saved individually, we can expect little data to be lost should a problem occur such as loss of power. The quadrat data dictionaries are large which can slow down the operating speed of the PDA and in extreme cases may cause the PDA to crash or hang at some period during the field season. It is therefore important to backup data onto a SD card, especially as you are likely to build up a weeks work of quadrats on your PDA before any of it is transferred. As each quadrat file is completed, backup it up onto a SD card.

Data is backed up using SD cards. Data can easily be sent from the PDA to a SD card using the **File Manager** section within TerraSync. With quadrat files closed, select **Data** (top left corner) and then select **File Manager** and choose **Data files** as File Type and make sure you have the correct location ("Default"). This brings up a list of all the files created as shown below. These are the quadrat files which have been recorded.



To copy a file to the SD card **highlight the desired file**, tap **Options** and from the drop down menu select **Copy to > SD card**. This creates a copy of the data file on the SD card using the same file name. If a message appears saying unable to save to storage card, remove the storage card and re-insert it and try again. You can also create a copy on the default drive. Do not delete the original file on the device, keep all files in case of any unexpected errors. Files can also be renamed using the **Options** function.

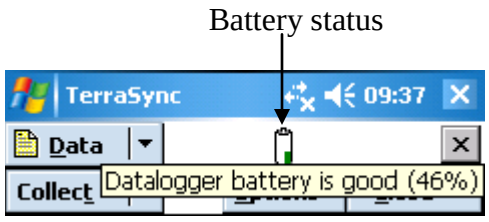


The SD card is for backup of data only. Do not use the SD card as the working drive. Always use the default drive on the PDA as the working directory. Data will always be downloaded from the default drive on the PDA and not the SD card. The SD card is only to be used to backup data.

3.10 Additional Battery Tips

Always be aware of the possibility of losing data. The main threat is battery loss, which if occurs may result in the lost of any data created since the last save (usually your last quadrat). TerraSync shows the battery status on the top menu bar (as shown below). If you put the stylus over the battery icon it will tell you the battery status. Alternatively if you tap **Start** (from the Windows menu) **> Settings > System tab** (at bottom) **> Power**, this also shows the remaining battery power. Note that it is only the Main Battery level and not the Backup Battery level that is significant.

Make sure all handhelds are recharged fully each night. Turn them off when recharging as this speeds up the process. Recharging may take between 8-12hours if a full recharge is needed. Rather than recharge on a Friday afternoon and leave it over the weekend – it is best to always recharge the night before field work, that way you can be sure of a fully charged battery. Failure to recharge can mean you and your partner lose half a day of time and travel.



The appendix has been removed under Regulation 12(5)(g) of the Environmental Information Regulations 2004. This regulation states that a public authority may refuse to supply environmental information in order to protect the environment to which it relates.

Appendix 3. Trimble GeoExplorer XM handheld user guide

The Trimble GeoExplorer XM handheld will be used for quadrat recording.

Trimble Geo XM handheld and accessories.

This is a rugged PDA system with integrated GPS. It has 1-3 metre accuracy and an all day internally rechargeable battery. When fully charged (this takes approx. 8 hours), the internal battery provides enough power for a full working day using GPS. Working practice is to keep the GPS turned off until you need to use it. Take care not to scratch the "touch" screen. When not recording always keep the PDA in the holding pouch on a belt with the screen facing towards you.

3.1 Accessories

- Support module with power supply and USB data cable
- Getting Started Guide
- Hand strap
- Pouch with belt loop
- Stylus kit (included is a cord which can be attached to the stylus in order to keep it safe).

3.2 Parts of the GeoExplorer 2005 series handheld
The following pages show the main features of the handheld.

Integrated GPS receiver
- High-performance
- Integrated SBAS (WAAS / EGNOS / MSAS) receiver
- EVEREST multipath rejection technology (GeoXT and GeoXH only)
- H-Star technology (GeoXH only) for improved accuracy with shorter occupation times

External antenna connector
Connection to an optional external GPS antenna.

Integrated Bluetooth and WLAN radios
- Connect to external devices using Bluetooth™ wireless technology.
- Connect to networks and the Internet using Wireless Local Area Network (WLAN) connectivity.

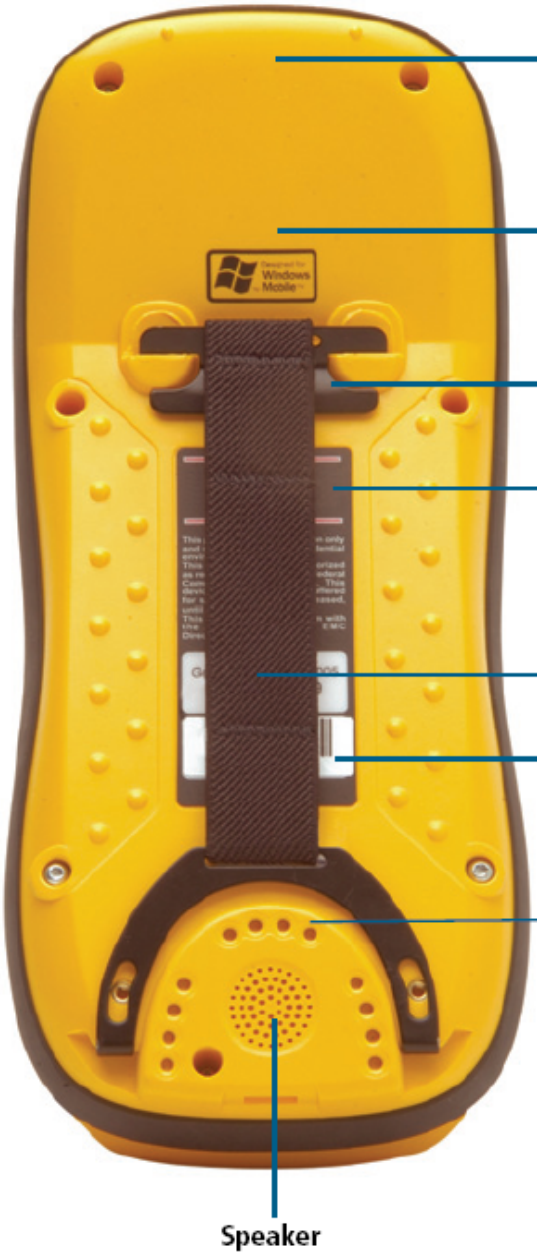
Pocket PC
Field computer running Windows Mobile Version 5.0 software for Pocket PC.

Advanced TFT color display
- 16-bit color (65,536 colors)
- Interactive touch screen
- ¼ VGA display
- Backlight

Keypad
Provides 11 buttons for fast, easy access to common actions, including OK and Start. Also provides Display and Power buttons, and buttons for navigation

Microphone
Run Notes and use the Recording toolbar to record.

SD card slot
Provides removable storage using SD (Secure Digital) memory cards



GPS COM ports
NMEA, TSIP, and real-time communication with integrated GPS receiver.

CPU
416 MHz Intel PXA-270 X-Scale processor.

Main memory
64 MB RAM.

Flash Disk
- Internal flash memory
- Non-volatile
- 512 MB

Handstrap

Internal battery
All-day operation with GPS.

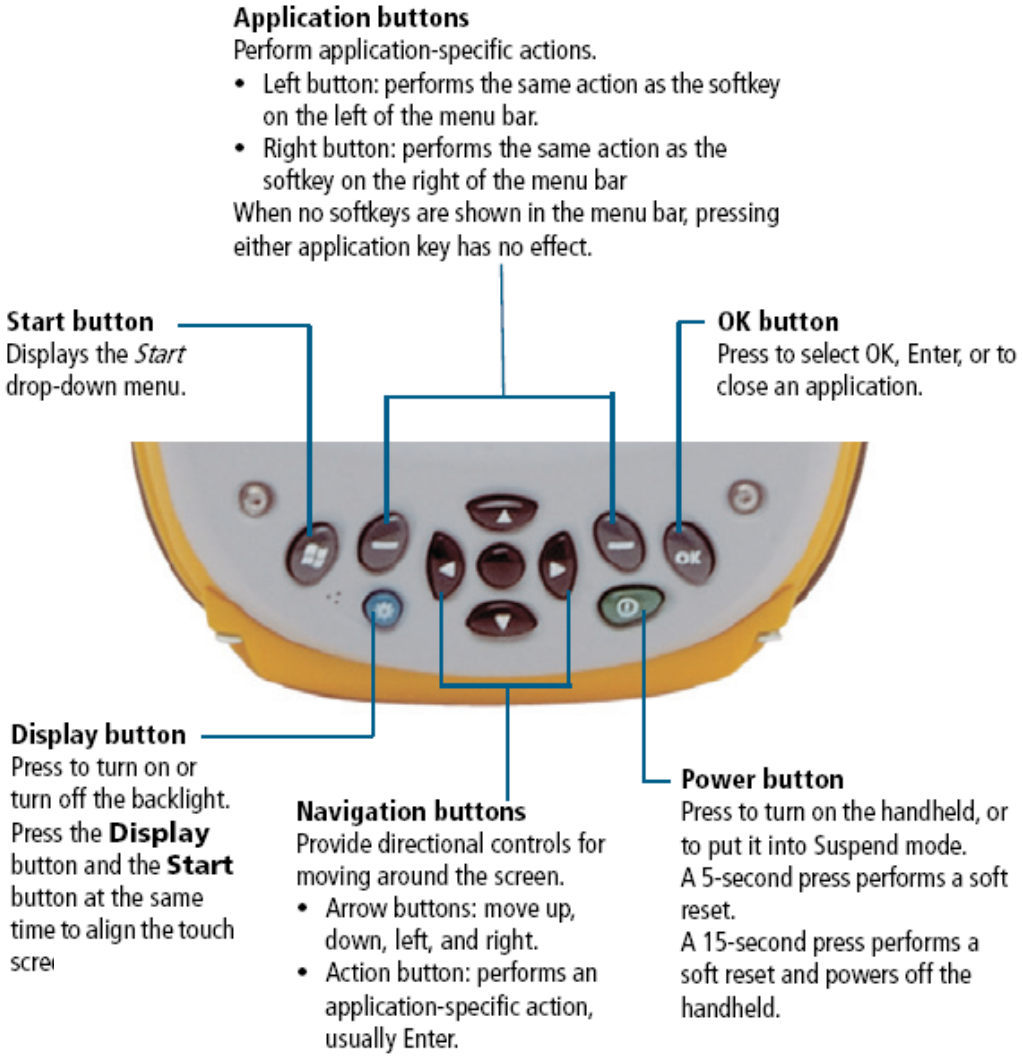
Communication swipes
Place handheld in support module to:
- charge the battery
- provide USB or cabled Ethernet connection to a computer

Attach optional serial clip to:
- charge battery
- provide external power
- connect to an external device such as a GeoBeacon receiver or mobile phone

Speaker

3.3 Keypad

The keypad provides 11 buttons for fast, easy access to common actions. The diagram below provides information about each button.



Note: A soft reset (a 5 second press on the Power button) stops all running applications but does not erase any programs or saved data. Put into suspend mode when not entering data (e.g. when setting up or assessing a quadrat).

3.4 Charging the battery

To charge the battery, connect one end of the AC adaptor cable to the support module and the other to an AC power outlet. Put the handheld in the support module as shown. It should click into place easily and the green light on the charger should come on. Do not force the PDA into the charger socket pins. It should just push in easily.

Leave to charge for up to eight hours to provide enough power for a full working day. To remove the handheld from the support module, press the release button on the support module, then lift the bottom of the handheld upward. Always charge the battery fully overnight ready for the next days field work. Make sure charging is occurring before you leave it. To remove the AC adaptor cable from the support module just turn the connector plug clockwise and pull to release.

3.5 Conserving the battery

In daylight you don't need the backlight. If you press the **display** button (blue button), the backlight will switch off. Pressing the **display** button again turns the backlight on. Do not forget to turn it off again. Polaroid sun glasses make the screen more visible. The backlight will automatically turn off if device is not used for 1 minute to conserve battery power. To switch back light on again just tap the screen with the stylus.

After 3 minutes the PDA will automatically go into suspend mode - a low-power mode that maintains the main memory contents but does not allow you to operate any of the handheld's functions. Again this is to conserve the battery. When this happens, just tap the **Power** button which returns to the same screen where you left off. When in suspend mode the device uses very little battery – it is much the same as turning off the device. Alternatively, you can suspend the PDA manually by pressing the **Power** button (e.g. when setting up or assessing a quadrat) to increase the battery life.

3.6 Turn on/off and suspend

Press and release the **Power** button to turn on or to suspend the handheld. When you press the **Power** button to turn off the handheld, the handheld goes into Suspend mode. This is a low-power mode that maintains the main memory contents but does not allow you to operate any of the handheld's functions. The handheld appears to be turned off. The integrated GPS receiver is

turned off and any application using GPS is disconnected. To turn on the handheld when it is in Suspend mode, press the **Power** button. The handheld is ready for operation. There may be a delay of up to 30 seconds while the integrated GPS receiver automatically reactivates. To turn off the handheld, press and hold the **Power** button for 20 seconds.

In order to conserve battery you may want to suspend the handheld by pressing the **Power** button for example, when assessing a quadrat. The device will automatically go into suspend mode when idle for 3 minutes. Again press the Power button to turn device on again for operation – and switch the back-light off each time. If the PDA "hangs", keep the **Power** button held down for 20 – 30 seconds and the software will reboot.

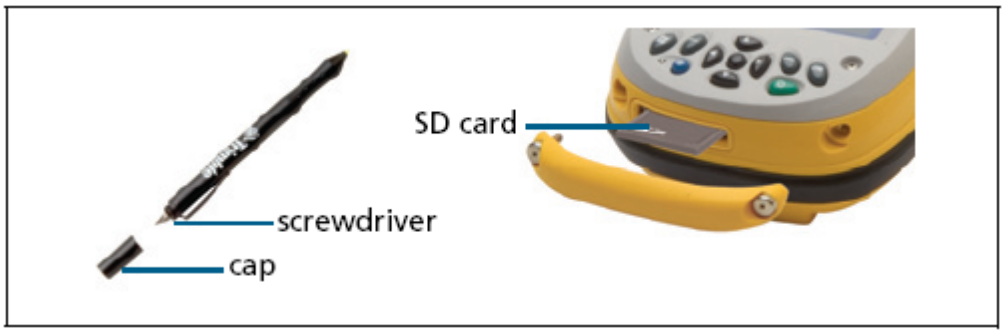
3.7 Storage / Backup data

The system has two kinds of memory, flash and RAM. Flash memory is permanent storage; the contents of flash memory are unaffected if the battery is removed or discharged. RAM memory is volatile. This means the contents will be lost if the battery is disconnected or discharged.

For NICS quadrats, data is automatically saved in the flash memory within TerraSync folder in *My documents*. It is important that data is backed up regularly during the day on to SD storage card as well as on the flash memory, therefore if battery fails, minimum data is lost. To save data in an alternative location to the flash disk, the handheld has a **Secure Digital (SD) Memory Card slot**. You should use SD memory cards to make copies of quadrat data when completed.

To insert an SD memory card:

1. Unscrew the stylus cap to access the screwdriver.



2. Use the screwdriver to undo both screws on the SD door.
3. Insert the SD memory card into the SD slot (label side up).
4. Reattach the SD door, insert both screws and tighten. Ensure that it is attached correctly.
5. Replace the stylus cap.

To remove an SD memory card:

1. Remove the SD door (see steps 1 to 2 above).
2. To eject the SD card from the SD card slot, push the card in. The card pops out.
3. Remove the card and, if you want to, insert a new SD card.

4. Reattach the SD door, insert both screws and tighten.
5. Replace the stylus cap.

Documents and program files that are stored on the flash disk are not affected by power loss or resetting. This means that if you turn the PDA off at any stage, your data is safe. However, you can lose data if you accidentally delete or overwrite the file containing it. Windows Mobile Version 5.0 software does not include a Recycle Bin. If files are deleted from the flash disk, they are deleted permanently therefore be careful.

3.8 What is GPS?

The Global Positioning System (GPS) is a satellite-based positioning system. A constellation of operational NAVSTAR satellites orbit the earth every 12 hours, providing worldwide, all-weather, 24-hour time and position information.

3.8.1 Getting a clear view of the sky

To receive signals from GPS satellites, the receiver must have a clear view of the sky. *GPS does not work indoors*. Hold the handheld with the screen toward you. The internal antenna is located above the screen under the Trimble logo. You do not have to hold the handheld perfectly level, but keep the antenna facing upward, not downward or sideways. Anything that blocks light also blocks signals. Satellite signals can be blocked by people, buildings, heavy tree cover, large vehicles, or powerful transmitters. GPS signals can go through leaves, plastic, and glass, but these all weaken the signal.

3.8.2 Using GPS

The integrated GPS receiver is normally switched off. To use GPS, take the handheld outside to a location with a clear view of the sky. From the *Today* screen, tap the *GPS* softkey in the menu bar (or alternatively open the TerraSync program). The skyplot of the default GPS software appears (in our case this is TerraSync software). Taking GPS quadrat locations is covered in the TerraSync user guide – section 3.6.1. When recording quadat data, you will be using the TerraSync software and will access the GPS within this program. For health and safety, do not use GPS during lightening.

3.8.3 Factors that affect accuracy

The accuracy of the GPS data increases with the number of satellites being used. Trimble data collection software only logs GPS positions when four or more satellites are visible. Accuracy also decreases if the view of the sky is partially blocked causing a weak signal. Tree canopy is likely to result in a weaker signal and slightly less accurate GPS position. Thick canopy may mean no signal at all, however in most cases you should receive a relatively strong signal except when in thick forest.

3.9 Use and Care

• Keep the outer surface free of dirt and dust.
• Keep the communication swipes, the external antenna port and the SD card slot free of dirt and dust.
• Protect the touch screen from pressure and sharp or abrasive objects. Trimble recommends applying a screen protector to the device. However this can reduce the effectiveness of the stylus in which case feel free to remove the screen protectors.

3.10 Cleaning

To clean the handheld, wipe it with a clean dry cloth. Do *not* immerse the handheld in water.

Appendix 4. Trimble Recon handheld user guide

The Trimble Recon handheld has no GPS system and therefore will only be used in emergencies or in thick woodland where no GPS signal is expected. As this PDA has no GPS capabilities navigation to the quadrat should be by compass and measuring.

Trimble Recon

This is a rugged PDA system with an internal rechargeable battery. When fully charged (approx 12 hours) it should provide between 12-15 hours of battery life.

4.1 Accessories

• International AC battery charger (100–240 V)
• 10 screen protectors
• 2 stylus pens
• Getting Started Guide
• Hand strap
• USB data cable

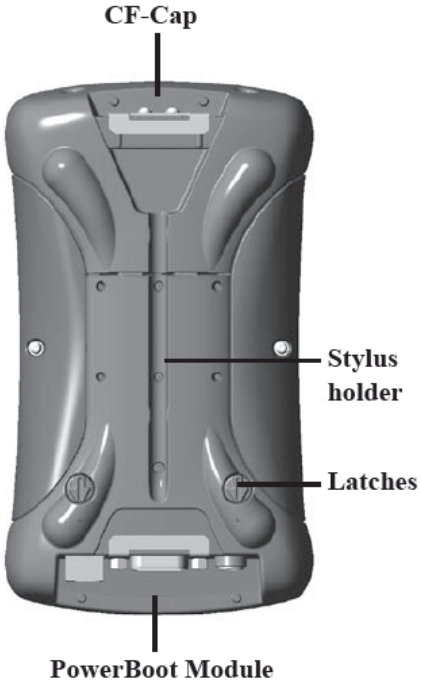
4.2 The Device

The main features of the handheld are illustrated below.

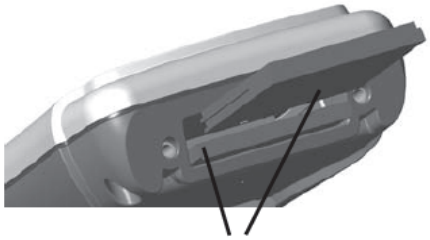
Front Panel

*Assignable application buttons; see Settings.

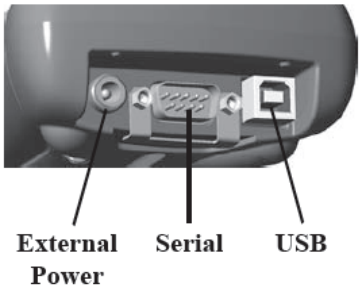
Back Panel



Top View- without Cap



Bottom View



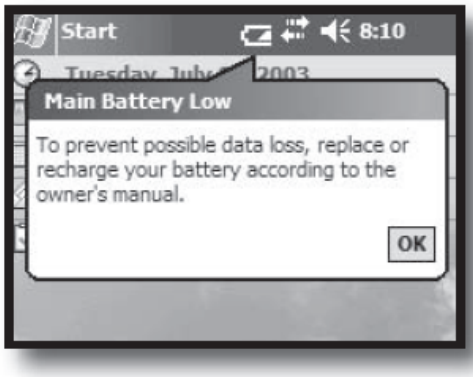
4.3 Charging the Battery

Connect the AC adapter to the external power port on the Recon. Charge the PowerBoot for at least 12 hours. For faster charging, turn the Recon off while charging the PowerBoot.

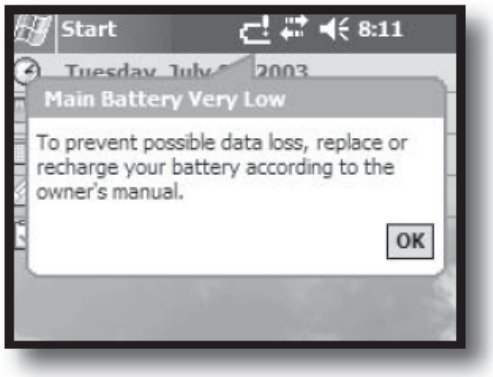
The Recon PowerBoot module contains a generous 3800 mAh of battery power and typically you can expect around 15 hours of battery life. A tip to extend the battery life is to use the backlight only when necessary. Tap on **Settings/ System / Backlight** to minimize the amount of time the backlight stays on when the unit is idle.

Low Battery Warnings: The Recon provides two different warnings when the battery life is getting low:

Low Battery Warning



Critical Battery Warning



The Main Battery Low warning is just a reminder that you should recharge your battery at the next convenient opportunity. You have approximately 30% of your battery life remaining, so there is no imminent danger that you are about to lose your data. The Main Battery Very Low warning means you that you have less than an hour (and possibly only a few minutes) before the Recon will turn itself off. It is recommended that you save your work immediately and turn the Recon off.

4.4 Turning your Recon on and off

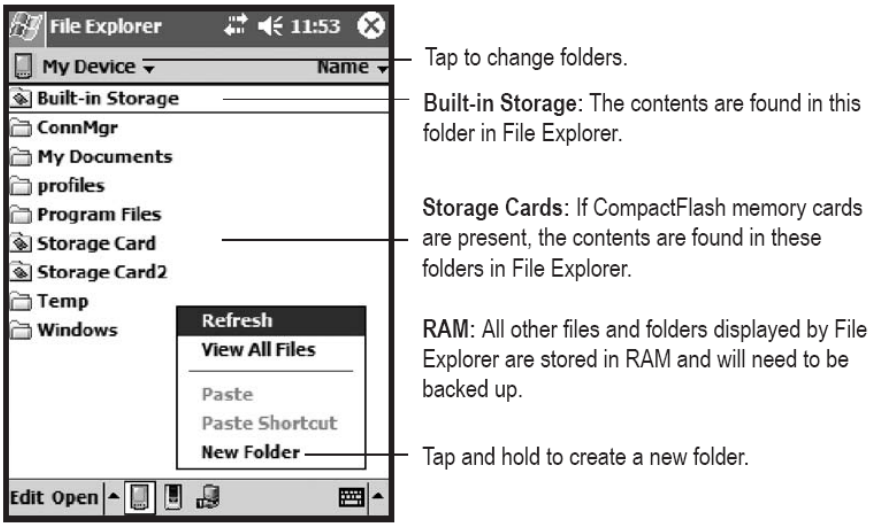
To start working, press the power button. When you have finished working, turn off by pressing the power button. After 3 minutes the recon will automatically go into suspend mode - a low-power mode that maintains the main memory contents but does not allow you to operate any of the handheld's functions. Again this is to conserve the battery. When this happens, just tap the power button which returns to the same screen where you left off. When in suspend mode the device uses very little battery – it is much the same as turning off the device. You should normally use the suspend mode when not recording, e.g., setting up a quadrat. The backlight will automatically turn off if device is not used for 1 minute to conserve battery power. To switch back light on again just tap the screen with the stylus.

4.5 Using the CF Expansion Slots

To use the CompactFlash expansion slots, you must first remove the CF-Cap. To do this, unscrew the two screws on the top of the CF-Cap. Slide the cap off the main unit. Gently insert a CompactFlash card or device into one of the two CF slots. Do not force the card into the slot. Cards must be inserted with the face toward the display side of the Recon. Replace the CF-Cap and tighten the screws to reseal.

4.6 Storage / Backup data

The Recon has two kinds of memory, flash and RAM. Flash memory is permanent storage; the contents of flash memory are unaffected if the battery is removed or discharged. RAM memory is volatile. This means the contents will be lost if the battery is disconnected or discharged. The picture BELOW shows the kinds of memory as they appear within the File Explorer (Start / File Explorer). The non-volatile built-in flash storage is at the top of the list.



NICS quadrat data is automatically saved in the flash memory within TerraSync folder in *My documents*. It is important that each quadrat data file is backed up, when finished, onto the compact flash storage card, therefore if battery fails, minimum data is lost. Windows Mobile Version 5.0 software does not include a Recycle Bin. If files are deleted from the flash disk, they are deleted permanently therefore be careful.

4.7 Cleaning and Care

Clean the Recon with a soft cloth dampened with either water or a diluted mild detergent. Use only the included stylus or other devices specifically designed for use with touch screens. The use of ballpoint pens, sticks, nails or other sharp objects to operate the touch screen will scratch and/or damage the unit. Abrasives may scratch touch screens. Keep the touch screen clean by gently wiping the display, using a soft cloth dampened either with clean water or glass cleaner.

Appendix 5. TerraSync software - Quick start user guide

5.1 Open TerraSync

Open TerraSync by tapping **Start** and then tapping **Terrasync** from the popup menu.

5.2 View NICS survey square as background map

Select **Map**, then tap **Layers** and select **Background File**. Select **File Type** as **Background** in the drop down menu, then **highlight the desired background file** and tap **OK**. If you want to view your GPS trail, tap **Layers > GPS Trail**,

5.3 Set Coordinate System

Select **Setup** (top left corner), tap **Coordinate System** button, select **Ireland** under **System**, **Irish Map Grid 1975** under **Zone** and select **Metres** under **Coordinate Units**, then tap **OK**. This sets everything to Irish National Grid.

5.4 Create quadrat data file

Select **Data** then select **New**. In subsequent screen, select **Rover** as **File Type**, type file name (e.g. **A012_W01a** as on work schedule sheet) into **File Name** and select appropriate data dictionary under **Dictionary Name**, then hit **Create**. Just tap **OK** when asked to confirm antenna height.

5.5 Recording quadrat attributes

5.5.1 Collecting new species attributes (Species data dictionary)

With the quadrat species data file open make sure **Data** and **Collect** are selected (top left corner), highlight **Quadrat** from the list, then tap **Create**. This brings up a quadrat species recording form. Enter **Quadrat ID** (as on work schedule sheet) and enter or select all data in the **text boxes** or **drop down menus**. Capture GPS point in bottom left corner of quadrat – see section 5.5.3. When complete tap **OK** which returns to the Choose Feature screen.

5.5.2 Collecting new environment attributes (Environment data dictionary)

With the quadrat environment data file open make sure **Data** and **Collect** are selected (top left corner), highlight **Env** from the list, then tap **Create**. This brings up a quadrat environment recording form. Enter **Quadrat ID** (as on work schedule sheet) and enter or select all appropriate environment data in the **text boxes** or **drop down menus**. When complete tap **OK** which returns to the Choose Feature screen.

5.5.3 Logging GPS point

Log Later is set as the default setting on the **Choose Feature** screen (**Options > Log Later**). With a quadrat species file open, species recorded as is section 5.5.1and GPS connected (section 5.8), tap **Log** and wait for **0 to change to 1** on the top toolbar. When **1** appears quickly hit **Pause** and then **OK**.

5.5.4 Updating attributes

With a quadrat data file open make sure **Data** and **Update** are selected (top left corner). A list of the previously recorded quadrats appears, **highlight** the desired quadrat and tap **Begin**. This opens the form for that particular quadrat. Any changes are made and once finished tap **OK** to return to the Choose Feature screen.

5.6 Ending the data collection session

When the data collection session is complete, close the data file and exit the TerraSync software. To close the open data file and exit the TerraSync software, tap **Close** in the **Collect Features** screen. A message appears, asking you to confirm that you want to close the open file. Tap **Yes** to close the current data file and return to the **New File** screen. Tap the **Close** button ☒ in the upper right corner of the screen. A message appears, asking you to confirm that you want to exit the TerraSync software. Tap **Yes** to exit the TerraSync software.

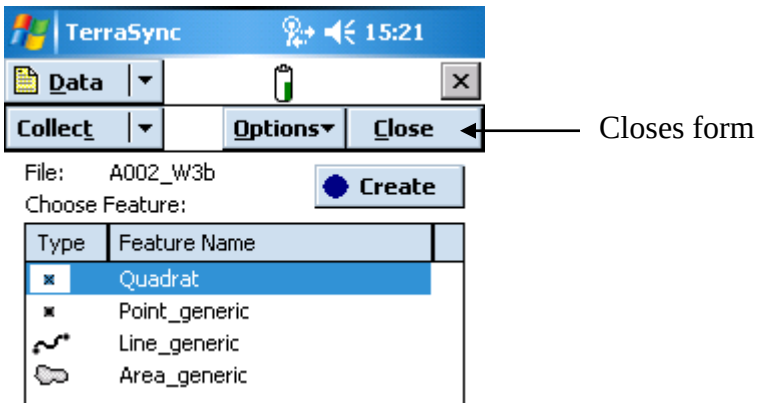
5.7 Open existing file
Select **Data** and **Existing File** in the sub menu (top left corner). Note existing file will not be available if you already have a data entry form open – once you close any open form (tap **Close** button), only then will **Existing file** become available. **Highlight** the **desired quadrat file** from the list, tap **Open** and again tap **OK** when asked to confirm antenna height. This brings the recorded quadrat for that file.

5.8 Connecting to the GPS
Select **Setup** (top left), tap **Options** and select **Connect to GPS**. If this is not available then you are already connected.

5.9 Disconnecting from the GPS
Select **Setup** (top left), tap **Options** and select **Disconnect from GPS**. If this is not available then you are already disconnected.

5.10 Backing up attribute data
Make sure **Data** is selected and then select **File Manager** (top left corner). Choose **Data files** as **File Type** and make sure the correct location is selected ("default"). **Highlight** the file you want copied to the memory card and then tap **Options** and from drop down list choose **Copy to > SD card**.

5.11 Troubleshooting
If at any time, an option is not available, then it is likely that you may already have a data form open. For example you will not be able to open an existing file if you already have a data form open as shown below. Need to tap **Close** button (NOT  as this will close TerraSync) and only then will existing file become available.



Note if the PDA stops operating in the field it is likely that the battery has run down. Do your best to make sure the PDA never fully loses power. An alternative is that the PDA has "froze" (sometimes with the screen still lit). If the PDA has frozen, hold down the green power button for at least 15 seconds and it will power-off. However this may result in loss of data in the quadrat form which was open at the time which the PDA froze.

When saving data to the storage card, if a message appears saying unable to save to storage card, remove the storage card and re-insert it and try again.

Appendix 6. Paper NICS Quadrat location map 2009

NICS Quadrat location map 2009

Quadrat ID ..... Field Surveyors ..... Date .....
.....

Location map

Location notes

Target notes

NICS2007 Quadrat Survey Field Manual: PART 3.

Species Recording

CONTENTS

PART 3. SPECIES RECORDING

Introduction

A PDA list of species with full botanical latin binomial denoting genus and species is provided for each quadrat survey. Note: species encountered during the course of quadrat survey which are not on the PDA list, should be recorded by botanical latin name, cover and height values where appropriate. Standard floras are essential for a reliable identification of any unknown specimens. If confirmation of identification is required, bring in a specimen sealed in a poly bag labelled with quadrat ID and PDA species number. The project staff will confirm ID. Garden escapes can be difficult to identify and may be allocated to genus level if necessary

Trees and shrubs are additionally classified by height class, i.e. <1.3m, 1.3m – 5m and >=5m. This matches the recording methodology of NICS2007 woodland habitat survey. The branches of shrubs/trees can overhang the plot at any height level contributing to species cover. Shrubs/trees should always be recorded by their actual height class regardless of at what height their branches overhang the plot.

In the field, surveyors should check that each species has an associated cover value before completion of the PDA data file.

Species Combinations

Species which are difficult to identify separately in the field are combined in the recording scheme, ie.

Cardamine flexuosa / hirsuta
Dactylorhiza fuchsii / maculata
Epilobium hirsutum / parviflorum
Geum urbanum / rivale
Glyceria declinata / fluitans / plicata
Juncus acutiflorus / articulatus
Lolium multiflorum (rolled leaf *multiflorum* / *perenne* cultivars)
Lolium perenne (folded leaf *multiflorum* / *perenne* cultivars)
Luzula campestris / multiflora
Sphagnum capillifolium / subnitens
Sphagnum palustre / papillosum

Species Groups

Groups of species occurring in the ground layer eg. herbs, dwarf shrubs are recorded with a total cover value in the environment files. Fruticose (bushy) lichens are an individual group as are bryophytes. Species groups for some woodand, grassland, heath and bog habitat vascular plants are listed in the following table.

Table 1. Species groups for ground layer vascular plants.

BOTANICAL	GROUP
Achillea millefolium	Herb
Achillea ptarmica	Herb
Aegopodium podagraria	Herb
Agrostis canina	Gramineae
Agrostis capillaris	Gramineae
Agropyron repens	Gramineae
Agrostis stolonifera	Gramineae
Ajuga reptans	Herb
Alchemilla vulgaris	Herb
Allium ursinum	Herb
Alopecurus geniculatus	Gramineae
Alopecurus pratensis	Gramineae
Anagallis tenella	Herb
Anemone nemorosa	Herb
Angelica sylvestris	Herb
Anthoxanthum odoratum	Gramineae
Anthriscus sylvestris	Herb
Apium nodiflorum	Herb
Arrhenatherum elatius	Gramineae
Arum maculatum	Herb
Asplenium trichomanes	Fern
Athyrium filix-femina	Fern
Bellis perennis	Herb
Blechnum spicant	Fern
Brachypodium sylvaticum	Gramineae
Briza media	Gramineae
Bromus hordeaceus	Gramineae
Bromus ramosus	Gramineae
Calluna vulgaris	Dwarf sh. & Heather
Caltha palustris	Herb
Calystegia sepium	Herb
Cardamine flexuosa/hirsuta	Herb
Cardamine pratensis	Herb
Carex binervis	Carex sp. & Cyperaceae
Carex curta	Carex sp. & Cyperaceae
Carex disticha	Carex sp. & Cyperaceae
Carex echinata	Carex sp. & Cyperaceae
Carex elata	Carex sp. & Cyperaceae
Carex flacca	Carex sp. & Cyperaceae
Carex hirta	Carex sp. & Cyperaceae

BOTANICAL	GROUP
Carex laevigata	Carex sp. & Cyperaceae
Carex nigra	Carex sp. & Cyperaceae
Carex otrubae	Carex sp. & Cyperaceae
Carex ovalis	Carex sp. & Cyperaceae
Carex panicea	Carex sp. & Cyperaceae
Carex pendula	Carex sp. & Cyperaceae
Carex pilulifera	Carex sp. & Cyperaceae
Carex pseudocyperus	Carex sp. & Cyperaceae
Carex pulicaris	Carex sp. & Cyperaceae
Carex remota	Carex sp. & Cyperaceae
Carex rostrata	Carex sp. & Cyperaceae
Carex sylvatica	Carex sp. & Cyperaceae
Carex vesicaria	Carex sp. & Cyperaceae
Carex viridula	Carex sp. & Cyperaceae
Centaurea nigra	Herb
Cerastium fontanum	Herb
Chrysosplenium oppositifolium	Herb
Circaea lutetiana	Herb
Cirsium arvense	Herb & Ag. Weed
Cirsium dissectum	Herb
Cirsium palustre	Herb
Cirsium vulgare	Herb & Ag. Weed
Callitriche sp.	Herb
Conopodium majus	Herb
Cynosurus cristatus	Gramineae
Dactylorhiza fuchsii/maculata	Herb
Dactylis glomerata	Gramineae
Danthonia decumbens	Gramineae
Deschampsia cespitosa	Gramineae
Deschampsia flexuosa	Gramineae
Digitalis purpurea	Herb
Drosera longifolia	Herb
Drosera rotundifolia	Herb
Dryopteris dilatata	Fern
Dryopteris filix-mas	Fern
Dryopteris pseudomas	Fern
Eleocharis palustris	Cyperaceae
Empetrum nigrum	Dwarf sh. & Heather
Epilobium angustifolium	Herb
Epilobium hirsutum/parviflorum	Herb
Epilobium montanum	Herb
Epilobium obscurum	Herb
Epilobium palustre	Herb
Equisetum arvense	Horsetail
Equisetum fluviatile	Horsetail
Equisetum palustre	Horsetail
Equisetum sylvaticum	Horsetail
Equisetum telmateia	Horsetail

BOTANICAL	GROUP
Erica cinerea	Dwarf sh. & Heather
Erica tetralix	Dwarf sh. & Heather
Eriophorum angustifolium	Cyperaceae
Eriophorum vaginatum	Cyperaceae
Euphrasia officinalis agg.	Herb
Fallopia japonica	Herb
Festuca arundinacea	Gramineae
Festuca ovina agg.	Gramineae
Festuca pratensis	Gramineae
Festuca rubra agg.	Gramineae
Filipendula ulmaria	Herb
Fragaria vesca	Herb
Galanthus nivalis	Herb
Galium aparine	Herb
Galium palustre	Herb
Galium saxatile	Herb
Galium verum	Herb
Geranium robertianum	Herb
Geranium sylvaticum	Herb
Geum urbanum/rivale	Herb
Glechoma hederacea	Herb
Glyceria spp.	Gramineae
Hedera helix	Climber/Scrambler
Helictotrichon pubescens	Gramineae
Heracleum mantegazzianum	Herb
Heracleum sphondylium	Herb
Holcus lanatus	Gramineae
Holcus mollis	Gramineae
Hyacinthoides non-scripta	Herb
Hydrocotyle vulgaris	Herb
Hypericum androsaemum	Herb
Hypericum pulchrum	Herb
Hypericum tetrapterum	Herb
Hypochaeris radicata	Herb
Impatiens glandulifera	Herb
Iris pseudacorus	Herb
Isolepis setacea	Cyperaceae
Juncus acutiflorus/articulatus	Juncus sp.
Juncus bufonius	Juncus sp.
Juncus bulbosus	Juncus sp.
Juncus conglomeratus	Juncus sp.
Juncus effusus	Juncus sp.
Juncus inflexus	Juncus sp.
Juncus squarrosus	Juncus sp.
Lamium maculatum	Herb
Lapsana communis	Herb
Lathyrus linifolius	Herb
Lathyrus pratensis	Herb

BOTANICAL	GROUP
Leontodon autumnalis	Herb
Leontodon taraxacoides	Herb
Leucanthemum vulgare	Herb
Linum catharticum	Herb
Lolium multiflorum	Gramineae
Lolium perenne	Gramineae
Lonicera periclymenum	Climber/Scrambler
Lotus corniculatus	Herb
Lotus pedunculatus	Herb
Luzula campestris/multiflora	Wood-rush (Juncaceae)
Luzula sylvatica	Wood-rush (Juncaceae)
Lychnis flos-cuculi	Herb
Lycopus europaeus	Herb
Lysimachia nemorum	Herb
Lysimachia nummularia	Herb
Lysimachia vulgaris	Herb
Mentha aquatica	Herb
Menyanthes trifoliata	Herb
Milium effusum	Gramineae
Molinia caerulea	Gramineae
Montia fontana	Herb
Myosotis discolor	Herb
Myosotis laxa	Herb
Myosotis scorpioides	Herb
Myosotis secunda	Herb
Myrica gale	Dwarf sh.
Nardus stricta	Gramineae
Narthecium ossifragum	Herb
Ophioglossum vulgatum	Fern
Orchis mascula	Herb
Oreopteris limbosperma	Fern
Osmunda regalis	Fern
Oxalis acetosella	Herb
Pedicularis palustris	Herb
Pedicularis sylvatica	Herb
Persicaria maculosa	Herb
Phalaris arundinacea	Gramineae
Phleum pratense	Gramineae
Phragmites communis	Gramineae
Phyllitis scolopendrium	Fern
Pilosella officinarum	Herb
Pinguicula lusitanica	Herb
Pinguicula vulgaris	Herb
Plantago lanceolata	Herb
Plantago major	Herb
Poa annua	Gramineae
Poa pratensis sens.lat.	Gramineae
Poa trivialis	Gramineae

BOTANICAL	GROUP
Polypodium vulgare	Fern
Polystichum aculeatum	Fern
Polygala serpyllifolia	Herb
Polystichum setiferum	Fern
Potamogeton polygonifolius	Herb
Potentilla anserina	Herb
Potentilla erecta	Herb
Potentilla palustris	Herb
Primula vulgaris	Herb
Prunella vulgaris	Herb
Pteridium aquilinum	Fern
Ranunculus acris	Herb
Ranunculus ficaria	Herb
Ranunculus flammula	Herb
Ranunculus repens	Herb
Rhinanthus minor	Herb
Rhynchospora alba	Cyperaceae
Rosa canina	Climber/Scrambler
Rubus fruticosus agg.	Climber/Scrambler
Rubus idaeus	Climber/Scrambler
Rumex acetosella	Herb
Rumex acetosa	Herb
Rumex crispus	Herb & Ag. weed
Rumex obtusifolius	Herb & Ag. weed
Sagina procumbens	Herb
Sanicula europaea	Herb
Scirpus cespitosus	Cyperaceae
Scirpus maritimus	Cyperaceae
Scrophularia nodosa	Herb
Selaginella selaginoides	Clubmoss
Senecio aquaticus	Herb
Senecio jacobaea	Herb & Ag. weed
Silene dioica	Herb
Sonchus arvensis	Herb
Stachys palustris	Herb
Stachys sylvatica	Herb
Stellaria alsine	Herb
Stellaria graminea	Herb
Stellaria holostea	Herb
Stellaria media	Herb
Stellaria palustris	Herb
Succisa pratensis	Herb
Taraxacum agg.	Herb
Thymus praecox	Herb
Trifolium dubium	Herb
Trifolium pratense	Herb
Trifolium repens	Herb
Tussilago farfara	Herb

BOTANICAL	GROUP
Typha angustifolia	Bulrush
Typha latifolia	Bulrush
Ulex gallii	Dwarf sh.
Urtica dioica	Herb
Vaccinium myrtillus	Dwarf sh.
Vaccinium oxycoccos	Dwarf sh.
Vaccinium vitis-idaea	Dwarf sh.
Valeriana officinalis	Herb
Veronica chamaedrys	Herb
Veronica montana	Herb
Veronica officinalis	Herb
Veronica serpyllifolia	Herb
Vicia cracca	Herb
Vicia sativa	Herb
Vicia sepium	Herb
Viola palustris	Herb
Viola riviniana	Herb

ISSN 1367-1979 (Print)
ISSN 1751-7796 (Online)

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Our aim is to protect, conserve and promote the natural and built environment for the benefit of present and future generations.