Survey of Coed Hyrddyn

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The Team:

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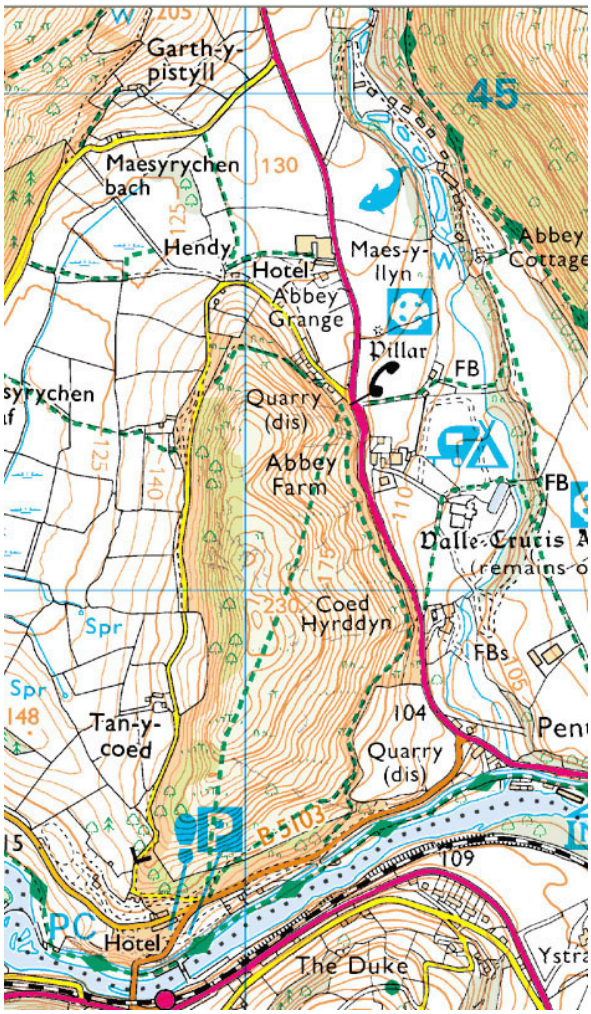
1) Introduction

Coed Hyrddyn (Hill 5166, Section 30C, OS 1:50000 Map 117, OS 1:25000 Maps 255/256, Grid Ref. SJ200439) is situated South of the Llantysilio hills and about 5km North West of Llangollen in North East Wales. It is listed as having a drop of 100m and therefore just qualifies for the list of one hundred metre prominence (HuMP) hills.

The purpose of this survey was to locate the positions of summit and bwlch and measure their heights accurately in order to determine if Coed Hyrddyn should retain its HuMP status.

Previously this hill had been listed under the name of Moel Tan y Coed. It is also known locally by English speakers as Velvet Hill. Both its Welsh and English name appear on National Trust signs, which are positioned at various access points to the hill.



2) Equipment used and Conditions for Survey

Ground surveys to determine the positions of the bwlch and summit were carried out using a Leica NA730 Professional Automatic level (X30 telescopic system)/tripod system and a "1m" **E**-staff extendable to 5m.

Absolute heights were measured using a Leica Geosystems Viva GS15 Professional receiver. This is a dual-frequency, 24-channel instrument, which means it can lock on to a maximum of 12 satellites and receive two signals (at different frequencies) from each of these satellites. The latter feature reduces inaccuracies that result from atmospheric degradation of the satellite signal. As a stand-alone instrument it is capable of giving position and height to an accuracy of about two metres and five metres respectively. Note that a hand-held GPS receiver can only receive up to 12 satellites and each at a single frequency and therefore it has a poorer positional accuracy of +/-5m and a height accuracy of no better than 10 metres. Despite the on-board features of the Viva GS15 receiver, there are still sources that create residual errors. To obtain accurate positions and heights, corrections were made to the GPS data via imported RINEX data from the Ordnance Survey which was post-processed using Leica Geo Office v7.01 software.

Conditions for the survey, which took place between 09.00hr and 13.00hr, were satisfactory. Although cold on the summit, 2 degrees Celsius, the wind was light. Conditions were overcast and although snow showers looked to be threatening, they did not materialise. Visibility at this low altitude was satisfactory, but the main summit region was obvious and therefore good visibility not a requirement. During the day the temperature increased slightly, and the forecast rain held off until after the completion of the survey.

3) The Survey

3.1) Character of Hill

Coed Hyrddyn, which is owned by the National Trust, is very accessible from the A542 road which runs South to North and East of the hill. There are a number of tracks that can be taken to reach the summit, but a convenient and short route is from the lay-by to the east of the summit where there is parking for a few cars. Although this route is the most direct, it maybe better to tackle the hill from the South or North outside winter since the East side is covered extensively with bracken.

The summit ridge lies in a North-South direction and is an excellent view point for all the neighbouring hills, Crucis Abbey and the town of Llangollen itself. It is just unfortunate that this excellent view point is somewhat spoiled by the unsightly caravan park that dominates the valley to the East. Although named Coed Hyrddyn on the OS 1:25000 map, woodland only covers the lower slopes and that mostly on the western side. The upper slopes are covered with "spongy" grass and walking is very pleasant.

The critical bwlch lies to the North in the vicinity of the Abbey Grange Hotel and the farm to the North of it. Since we needed access to the fields around this farm to carry out the survey of the bwlch, permission was requested from the farm and was willingly given.

3.2) Summary of Survey Method

The survey commenced on the summit of the hill where the highest point was easily determined by level and staff. This was the highest point of a grassy mound and there were no other points that were contenders. The Leica GS15 was set up over the summit position on a tripod using a Leica proprietary tribrach and optical plummet system and its height above the ground measured. Data were collected for 1 hour with an epoch time of 15 seconds.

The location of the position of the bwlch was carried out next having descended the hill and moved our cars to the Abbey Grange Hotel car park. The buildings, trees, and hedges around the fields, hampered the immediate visual determination of the position of the bwlch. It was necessary to carry out a short circuitous anticlockwise walk from the Abbey Grange Hotel, North to the minor road, west along it, and then return South by the footpath to the Abbey Grange Hotel in order to identify possible bwlch positions.

The level was set up on the tripod in the field to the West of the farm and we were able to eliminate possible bwlch positions to the North which visually we had thought to be contenders. However this area of land was clearly 1-3m higher and could be discounted. Since it was now clear that the exact position of the bwlch lay in the field where we had set up the level or in the rough land to the West of the Abbey Grange Hotel and South of our position, we were going to have to carry out time-consuming detailed survey work with level and staff. Therefore, we set up the Leica Viva GS15 on a two metre pole in the middle of the open field to collect data for 1 hour with an epoch time of 15 seconds. This position was chosen so that satellite signals to the Leica antenna would not be masked by the large trees in the vicinity of the track leading East to the farm.

To start the process to identify the bwlch position a row of flags was set out 10m apart in the valley to valley direction in the field and North of the farm buildings. Staff measurements from this and additional parallel lines confirmed that the hill to hill line of the bwlch was probably passing through the farm yard itself which would further complicate matters since this area was man-made land. However if we could show that the land in the valley to valley direction in the grounds of the Abbey Grange Hotel was lower, then this would eliminate the need for further surveying in the farmyard area. Staff measurements proved that this area of land was lower and therefore contained the position of the bwlch. This land was very uneven and had been churned with a multitude of tracks from large agricultural vehicles. Because of this unevenness and general overall flatness, it was not possible to take meaningful accurate staff measurements in this area. However we were able to identify that the bwlch lay in this area and by measuring the peaks and troughs in the tracks were able to estimate that our height measurements would be no better than +/-0.2m. Finally a staff reading was taken at the GPS set up position to obtain a height correction for the bwlch position.

3.3) The Summit

See photos in Appendix.

The ten-figure Grid References recorded for the summit were:-

Montana 600	SJ 20035 43948	Accuracy 3m Height = 236m
Garmin Map60CSx	SJ 20029 43946	Accuracy 2m Height = 229m
Garmin Venture	SJ 20032 43948	Accuracy 6m Height = 236m
Magellan Explorist 100	SJ 20031 43948	Accuracy 4m Height = 232m
Etrex	SJ 20030 43949	Accuracy 5m Height = 235m
Garmin Oregon 450	SJ 20033 43946	Accuracy 5m Height = 241m
Garmin Etrex Summit	SJ 20031 43949	Accuracy 4m Height = 245m

The Leica GS15 vertical offset used for the antenna mounted on the “Short Tripod” was measured by the integral tape to be 0.644m in addition to the 0.255m vertical offset associated with the tribrach/hook and clamp system. The position and height data for the summit that were recorded by the Leica Viva GS15 and post-processed with Leica GeoOffice 7.01 using imported OS RINEX data from the eight nearest OS base stations were:-

System	Easting	error(1SD)	Northing	error(1SD)	Height(m)	error(1SD)
GS15	320029.104	0.002	343943.328	0.001	232.410	0.007

The height of the summit is therefore 232.41m

3.4) The Bwlch

See photos in Appendix

As stated previously, it was not possible to pinpoint the position of the bwlch to the nearest metre because of the unevenness of the terrain which is clearly shown in the photograph. Therefore it is not relevant to quote 10 figure Grid References for this point. It is interesting to note that the identified bwlch position is the same as that estimated prior to the survey from contour interpolation on Ordnance Survey enlarged mapping on the Geograph website.

The eight-figure Grid References recorded for the bwlch were:-

Montana 600	SJ 2005 4464	Accuracy 3m	Height = 142m
Garmin Map60CSx	SJ 2005 4464	Accuracy 3m	Height = 131m

The staff readings to correct the height of the GPS data collection point to the bwlch were:-

Staff Reading at bwlch = 1.4+/-0.2m

Staff Reading at GPS setup position = 0.469m

The position and height data for the set up position for the bwlch that were recorded by the Leica Viva GS15 and post-processed with Leica GeoOffice 7.01 using imported OS RINEX data from the eight nearest OS base stations were:-

System	Easting	error(1SD)	Northing	error(1SD)	Height(m)	error(1SD)
GS15	320060.338	0.002	344719.925	0.001	131.337	0.011

The height of the bwlch is 131.337 +0.469 – 1.4 = 130.4m

4) Discussion of Results

Since the position of the hill's summit could be identified precisely, the main error associated with measurement is that associated with the GPS measurement itself for 1 hour of data collection. We would estimate this uncertainty to be +/-0.06m. However, by far the most significant error for the measurement of the height of the bwlch and hence the calculation of the drop arises from the height uncertainties in the bwlch location. As already stated, we have estimated this uncertainty to be +/-0.2m from staff measurements made in this area. The calculated drop from the measurements is 102.0+/-0.2m and therefore exceeds the minimum 100m required for HuMP status.

5) Summary and Conclusions

The **summit** of **Coed Hyrddyn** is at grid reference * SJ 20032 43948 and is the unfeatured top of a grassy mound. Its height is **232.41+/-0.06m**.

The critical **bwlch** for **Coed Hyrddyn** is at grid reference *SJ 2005 4464. Its height is **130.4+/-0.2m**.

The **drop** from the **summit to bwlch is 102.0+/-0.2m** and therefore **Coed Hyrddyn retains its HuMP classification.**

* NB average hand-held Garmin/Magellan GPS grid references are quoted in the summary.

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Appendix

Leica Viva GS15 set up on the summit of Coed Hyrddyn

Leica GS15 set up showing vertical offset (0.644m) at the summit of Coed Hyrddyn

The field containing the bwlch of Coed Hyrddyn

GPS set up for bwlch height measurement. (Bwlch behind row of trees)