

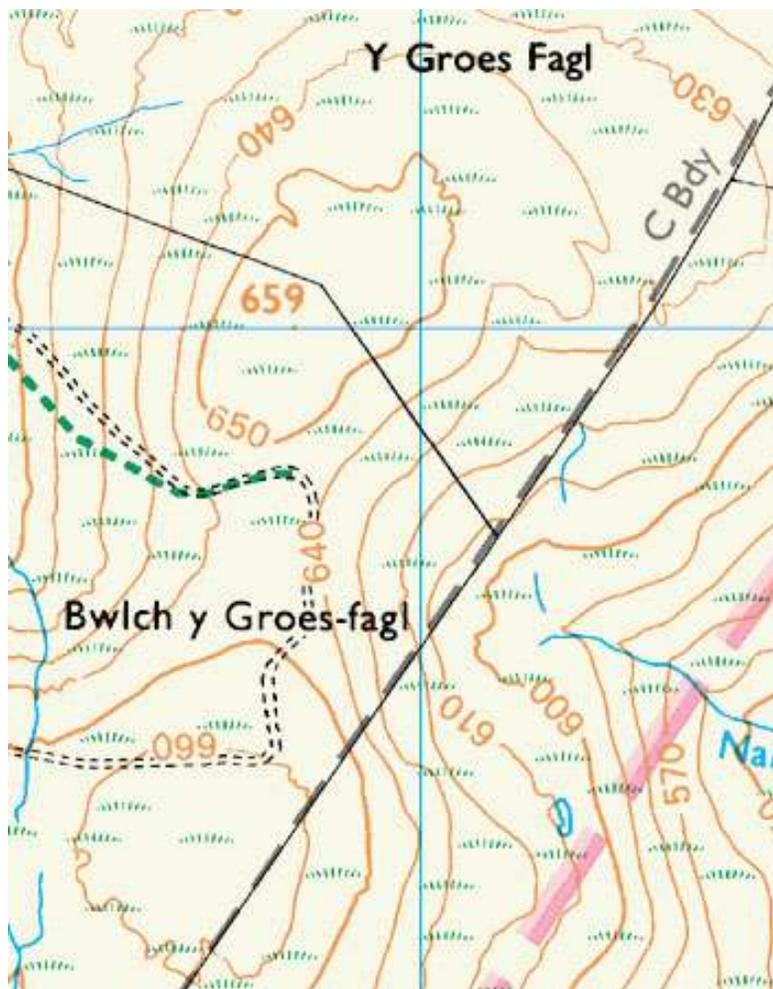
Survey of Y Groes Fagl

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1) Introduction

Y Groes Fagl (Hill 2107, Section 30E, OS 1:50000 Map 125, OS 1:25000 Map 255, current Grid Ref SH988290) is listed as a Nuttall. An extract of the OS 1:25k map, which is shown below, gives a spot height of 659m for the hill's summit. The contours for the bwlch to the South of the summit give a height between 640 and 650m which gives a drop in the range of 19 to 9m. The enlarged Geograph map gives a spot height of 644m for the bwlch giving a drop of 15m. This drop figure equates to the 50ft of ascent mentioned in John and Anne's Welsh guide published by Cicerone (*The Mountains of England and Wales, Volume 1: Wales, Third Edition 2009, page 129*). We presume that the Nuttalls surveyed this hill, but we do not know for sure.



The purpose of this survey was to locate the summit and bwlch positions of Y Groes Fagl and then to measure accurately the drop for this hill in order to see if this hill qualifies for the Nuttalls' list.

2) Equipment used and Conditions for Survey

The ground surveys to locate the positions of the summit and bwlch and the line survey between the two 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 Trimble GeoXH 6000 GNSS (Global Navigation Satellite System) receiver. This is a dual-frequency, multi-channel instrument, which means it is capable of locking on to a maximum of 12 GPS and 8 GLONASS satellites as availability dictates, 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 signals. 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 small hand-held GPS receivers used for general navigation can only receive up to 12 GPS satellites and each at a single frequency and therefore these instruments have a poorer positional accuracy of +/-5metres and a height accuracy of no better than +/-10 metres. Some recently produced hand held GPS Garmin receivers can also receive signals from GLONASS satellites which greatly improve the speed at which these units can achieve a satellite "fix". Despite the on-board features of the GeoXH 6000 receiver, there are still sources that create residual errors. To obtain accurate positions and heights, corrections were made to the GNSS data via imported RINEX data from the Ordnance Survey which were post-processed using Trimble GPS Pathfinder Office processing software.

Conditions for the survey, which took place between 11.00hr and 15.00hr BST were good. Visibility through the optics was clear but slightly hampered by a little heat haze and shimmer. It was warm, about 20 degrees Celsius, and with no wind.

3) The Survey

3.1) Character of Hill

Y Groes Fagl lies in the Western Berwyn to the South East of the Penllyn Forest which also lies South East of Llyn Tegid (Bala Lake). The Western Berwyn is a series of heather covered rounded hills where solitude can easily be found. These hills have generated the label "boring Berwyns" but they do have a certain wild attractiveness about them. However if ridges, pointed summits and crags are your desire then these hills are not for you! Although there are paths to most of the main hills now, going can be very tough and tedious. Fortunately a wide track runs from the highest point of Cwm Hirnant, where there is limited parking, to almost the summit of Y Groes Fagl thereby greatly improving the access to this group of hills. Small areas on these hills are covered with grass and are used for grazing sheep. Otherwise apart from an occasional grouse and a few meadow pipits there is not much nature to be seen unless you are lucky.

Y Groes Fagl is a rounded hill covered with a mixture of grass and heather on all sides. The summit is crowned with a 2m post (see photo in Appendix 1) although that may not be at the exact highest point. The bwlch lies approximately 200m to the South on the opposite side of the forestry track and is covered with grass, heather and peat.

3.2) Bwlch Survey

The hill to hill direction for the bwlch follows an almost North to South line. Following this line from the North and having crossed the main track the bwlch is crossed by two minor gullies. The

first of these is “Y” shaped with the two arms of the “Y” extending to the West. The second gully crosses the bwlch about 70m further to the South. These two features greatly simplify the survey of the bwlch because it is clear that the actual position of the bwlch must lie in one of them as they represent the lowest points in the hill to hill direction.

The Leica NA730 level was set up at a convenient point to the North of the “Y” gully so that staff readings could be taken in both gullies. A line of flags, each about 3m apart were then placed along the nearest arm of the “Y” gully and staff readings were taken at the positions of these flags. For about a 12m length of this gully the lowest staff readings, representing the highest points, were between 1.82 and 1.84m. Then a line of flags were placed at the same spacing along the other arm of the “Y” gully and very similar staff readings were obtained; all between 1.82m and 1.84m. Therefore within the limitation of the unevenness of the terrain in these gullies, the highest points were the same. However, when the other gully to the South was surveyed by the same procedure, the highest point was at a staff reading of 1.90m which was lower than the highest point of the “Y” gully by 0.08m. Therefore this point was the exact position of the bwlch and was marked with flags.

The following ten-figure grid references were taken:-

Bwlch:-

Garmin Montana 600	SH 98828 28770	Height = 647m
Garmin Etrex 20	SH 98830 28769	Height = 647m

In order to make sure that the undergrowth did not impede satellite reception to the Trimble, it was placed on an upturned “Tupperware Box” over the position of the bwlch. The height of this box was measured and thus a height correction was made for it. The position and height data for the bwlch were recorded by the Trimble GeoXH 6000 and processed in Trimble GPS Pathfinder Office using the five nearest base stations are given in the table below:-

System	Easting	error(1SD)	Northing	error(1SD)	Height(m)	error(1SD)
GeoXH 6000	98825.460	<0.05	28764.818	<0.05	643.466	<0.05

3.3) Line Survey

This procedure commenced at the bwlch where a staff reading had already been taken with the level set up on the tripod at a convenient position nearer Y Groes Fagl. Once this set of readings had been taken (Backsights BS) the staff was then moved to an uphill position, but the level not moved apart from a rotation through 180 degrees to take another set of readings (Foresights FS). This process of alternately moving the staff and level was repeated uphill until the final reading was taken with the staff on the summit position. Readings were taken from the horizontal and also the lower and upper stadia lines of the level to provide a check on any staff misreadings and to improve accuracy. If in any set of three readings the average was greater than 1mm different from the horizontal reading, then that set was remeasured. This procedure was repeated until the final reading was taken on the summit position.

The results of the survey are given in Appendix 2. The drop for Y Groes Fagl was measured to be 15.515m.

3.4) Summit Survey

The position of the summit was located during the final measurement of the line survey. Staff readings were systematically taken for all high ground in the vicinity of the summit post and the highest point was identified in grass about 3m away from the post. Once the line survey had been completed, the Trimble was placed on the ground over the summit and data were collected.

The position and height data for the summit were recorded by the Trimble GeoXH 6000 and processed in Trimble GPS Pathfinder Office using the five nearest base stations are given in the table below:-

System	Easting	error(1SD)	Northing	error(1SD)	Height(m)	error(1SD)
GeoXH 6000	98848.968	<0.05	29003.435	<0.05	658.984	<0.05

The following ten-figure grid references were taken:-

Summit:-

Garmin Montana 600 SH 98853 29007 Height = 664m

Garmin Etrex 20 SH 98853 29007 Height = 666m

4) Discussion of Results

The line survey measured the drop for Y Groes Fagl to be 15.515m and this is in excellent agreement with the same measurement taken from the Trimble GeoXH 6000 where it calculated to be 15.518m, just 3mm difference. The largest uncertainty in the line survey measurements would be the location of the bwlch where unevenness in the terrain caused by vegetation would give an estimated height error of approximately +/-0.10m. An estimate for the uncertainty in the summit height would be +/-0.05m. Therefore, combined with the typical error for a line survey taken over a 6 reading set of +/-0.03m, we would estimate that the overall uncertainty for the drop measurement calculated from the line survey to be +/-0.15m. Therefore the drop is 15. 52+/-0.15m

SQC measurements with the Trimble GeoXH 6000 have shown three times standard deviation to be +/-0.15m. Therefore, combined with the uncertainties in the heights of the bwlch and summit mentioned above, the measured drop is 15.5+/-0.25m

Both the line survey and Trimble GeoXH 6000 measurements show the drop exceeds 15m within the measurement uncertainties and therefore Y Groes Fagl's Nuttall status is confirmed.

5) Summary and Conclusions

The **summit** of **Y Groes Fagl** is at grid reference * **SH 98853 29007** and has no feature but is adjacent to the 2m high pole.

The **bwlch** of **Y Groes Fagl** is at grid reference ***SH 98829 28770** and has no feature but is at the bottom of a transverse gully.

The measured **drop** for **Y Groes Fagl** is **15.5+/-0.15m** and therefore this hill **retains its Nuttall status**.

- NB average hand-held Garmin GNSS grids are quoted in the summary.

John Barnard and Myrddyn Phillips 23 June 2014.

Appendix 1

Surveying the summit of Y Groes Fagl



Appendix 2

Title:- Survey of Y Groes Fagl

Instrument:- Leica NA730 Automatic level

Date:-

13/06/2014

Point Number	Horizontal Line		Lower Stadia Line		Upper Stadia Line		Mean BS metres	Mean FS metres	Height Difference metres	
	Backsight BS metres	Foresight FS metres	Backsight BS metres	Foresight FS metres	Backsight BS metres	Foresight FS metres				
1	1.900	0.405	N/A	0.280	N/A	0.530	1.900	0.405		
2	1.771	1.292	1.475	1.195	2.067	1.388	1.771	1.292		
3	4.743	0.162	4.579	0.137	4.908	0.185	4.743	0.161		
4	4.660	0.947	4.518	0.834	4.802	1.060	4.660	0.947		
5	4.549	0.645	4.383	0.541	4.714	0.747	4.549	0.644		
6	2.072	0.730	1.899	N/A	2.244	N/A	2.072	0.730		
							SUM =	19.695	4.179	15.515

Bwch to Summit (JB Level and Data recording, MP Staff)