Survey of Carn Aosda

27 February 2015

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1) Introduction

Carn Aosda (Hill Number 438, Section 06B, OS 1:50000 Map 43, OS 1:25000 Map 387N, Grid Ref NO134791) is currently listed in the Database of British and Irish Hills as a Munro. However, at 917m it is possible that an accurate height measurement may show it to be less than 914.4m (3000ft) in which case it would then be eligible for reclassification to a Corbett; spot heights on Ordnance Survey maps have a measurement uncertainty of +/-3m. The purpose of this survey was to measure accurately the height of Carn Aosda.

2) Equipment used and Conditions for Survey

The ground survey to locate the position of the 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 instrument is dual-frequency and multi-channel, which means it is capable of locking on to a maximum of 12 GPS and 8 GLONASS satellites as availability dictates, and receiving 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 Viva GS15 receiver, there are still sources that create residual errors. To obtain accurate positions and heights, corrections were made to the GNSS (Global Navigation Satellite System) data via imported RINEX data from the Ordnance Survey which were post-processed using Leica Geo Office 8.3 software.

Conditions for the survey, which took place between 10.00hr and 13.00hr GMT, were fair. Visibility through the optics was clear and there was no precipitation. However, there was a strong breeze measured with an anemometer to be 30mph and the temperature was 0 degrees Celsius. It was therefore essential to find shelter and a shallow hollow in the summit area about 50m distant from the cairn provided this.

3) The Survey

3.1) Character of Hill

Carn Aosda is situated at the top of the Cairnwell pass, the highest point of the route between Blairgowrie and Braemar, and it is a popular skiing area in the winter months. The slopes of the mountain are festooned with ski tows and snow fences and on our visit many people were enjoying the winter conditions. Among these was a large flock of snow buntings and the birds were making best use of spare food discarded by skiers. The mountain has fairly gentle slopes on its western, northern and southern flanks with only the eastern side having a few small crags. The vegetation is

heather on the lower slopes with scree slopes appearing higher up the mountain. The summit area is stony with sparse vegetation. Access to the summit follows a route between the ski runs and care has to be taken to ensure these are not crossed when in use. The snow was a few feet deep in many places, but as we gained height the snow pack hardened making progress by kicking steps fairly easy. Fortunately, the summit area itself was free of snow.

3.2) Summit Survey

Once at the summit, a visual inspection showed that the highest point was either in the vicinity of the cairn or a few metres SW where there was an outcrop. The Leica NA730 level was then set up at a convenient position and readings taken at various locations around the cairn and on the outcrop. The highest point was found to be a small embedded rock on the South side of the cairn. The cairn itself is a pile of stones with a radius of approximately 2m, but it is no more than about 0.75m in height. While it is possible for higher ground to lie under the stones, this is unlikely to be >0.1m higher than the embedded rock we identified as the summit.

The Leica Viva GS15 was set up on its short tripod configuration directly over the highest point and GNSS data were collected for 2 hours. The vertical offset used, as measured by the tape (see photograph in Appendix), was 0.591m. The data were processed using Leica GeoOffice v8.3, the computed Tropospheric Model and imported RINEX data from the seven nearest OS base stations under 100km distance. The results are shown below.

System	Easting	error(1SD)	Northing	error(1SD)	Height(m)	error(1SD)
GS15	313397.620	0.004	779163.929	0.001	915.345	0.006

The height of Carn Aosda is 915.35m.

4) Summary of Operating and Processing Conditions

	GS15
Data collection summit (min)	127
Number of Base Stations used in Processing for all points	7
Epoch Time (sec)	15
Tropospheric Model	Computed
Cut off Angle (degs)	15

5) Discussion of Results

The measurement uncertainty in height associated with location of the summit position is <1cm while that for the measurement itself is +/-0.05m. Therefore the height of Carn Aosda is 915.35+/-0.05m. The caveat in the measurement is that higher ground could lie under the cairn, but we estimated that this would be no more than 0.1m higher than our identified position.

6) Summary and Conclusions

The **summit** of **Carn Aosda** is at grid reference *** NO 13398 79155** and is a small embedded rock on the South side of the cairn and immediately adjacent to it. Its height is **915.35+/-0.1m.** Carn Aosda retains its classification as a Munro.

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

John Barnard, Graham Jackson and Myrddyn Phillips 12 June 2015.

Appendix 1

Vertical offset for Leica Viva GS15 on the summit of Carn Aosda

Leica Viva GS15 set up on summit