Population trends for wild *Galanthus woronowii* populations 2009-2023

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# Introduction

This report is to provide the CITES Authorities of Georgia with an update on the trends in population status of *Galanthus woronowii* (Snowdrop) populations in Georgia that are revealed through repeated field surveys carried out by multiple Georgian and international authorities and experts over the years 2009 to 2023. The report is a preliminary overview of the key trends as they relate to the conservation status of the wild populations and multiple further questions remain yet unanswered. We note some of the most important of these in the discussion and recommendations section of the report.

# Survey overview

Surveys of *Galanthus woronowii* wild populations were carried out in the years 2009, 2014, 2018 and 2023, using a similar methodology throughout. Results and methods for the 2009 survey were peer-reviewed and published in McGough et al. (2014).

Overall, 84 different wild sites around Georgia have been surveyed in the period. Most sites are in Ajara, Guria and Imereti regions (Table 1).

Table 1: Count of wild *Galanthus woronowii* sites surveyed in years 2009-2023.

|  |  |
| --- | --- |
| Region / Autonomous Republic | Count of sites surveyed |
| Ajara | 40 |
| Guria | 23 |
| Imereti | 18 |
| Mtskheta-Mtianeti | 2 |
| Tbilisi | 1 |
| Total | **84** |

Many sites were surveyed in multiple years although sites vary in which years they were surveyed. To our knowledge, there is no comprehensive map of the *G. woronowii* wild populations in Georgia (see recommendations) and the sites surveyed are those that are known to exist by Georgian botanists and bulb traders. The sites vary in their harvest histories and conservation status.

The wild site surveys consist of two major components. Firstly, documenting properties about the overall status of the site: location, conservation status, area. Secondly, undertaking quadrat-based counts of plant density. Taken together these data allow for the estimation of the density and abundance of plants across the surveyed populations and the calculation of an annual export quota.

The total number of sites surveyed per year in each region and by conservation value (Fig. 1 and Fig. 2, respectively) and the area of sites surveyed (Fig. 3 and Fig. 4, respectively) has varied over the survey years.

Fig. 1: Total sites surveyed per survey year per region (excluding 2 sites in Mtskheta-Mtianeti and 1 site in Tbilisi).

Fig. 2: Total sites surveyed per survey year by conservation value (excluding some unclassified sites).

Fig. 3: Total area of sites surveyed per survey year per region (excluding 2 sites in Mtskheta-Mtianeti and 1 site in Tbilisi)

Fig. 4: Total area of sites surveyed per survey year by conservation value (excluding some unclassified sites).

There are no strong trends in the overall numbers and areas of sites surveyed. One noteworthy trend is that the area and number of sites classified as high conservation value has tended to decline and the area and number of sites of lower conservation value has tended to increase. Inspection of the site data indicates that these trends are more to do with different sites being surveyed each year than any reclassification of conservation value (surveying less High conservation value sites and more Medium and Low). Over the period, 5 sights were downgraded from Medium to Low conservation value and one from High to Medium. Three sites were upgraded from Medium to High conservation value and two from Low to Medium.

# Population trends

Plant density and abundance dynamics for 2009-2014 indicate an order of magnitude variation over the period (Figs. 5 and 6) and different patterns of variation by region. Differences between the dynamics of density and abundance occur because overall site abundance is also influenced by the estimated area of each site, which is re-estimated every survey.

The apparently dramatic changes in many of the sites are backed up by statistical analyses of the changes in density and abundance by site (Table 2, abundance table omitted for brevity). All but one site decreased in plant density between 2009 and 2014, most didn’t change between 2014 and 2018, with some sites increasing and some decreasing in plant density, and most sites increased in plant density between 2018 and 2023. These dynamics are dominated by the Ajara sites because they are more numerous in the dataset and Ajara sites shows the same trend (Table 3). Sites in Guria and Imereti also declined in abundance in the 2009 to 2014 period (Table 3). However, there was a broader mix of significant increases, decreases and no-change for the 2014-2018 and 2018-2023 periods for Guria and Imereti (Table 3). These trends in density and abundance were generally consistent with trends seen across High, Medium and Low conservation value sites (Fig. 7).

Analysis of the magnitude of population change reveals quite dramatic changes in density and abundance apparent from the graphs (Figs. 5 and 6). Significant decreases were on average by around 50% (varies by period) and increases were on average by around 200%.

Table 2: Statistically significant changes in plant density between survey years

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year period** | **Increase** | **Decrease** | **No Change** | **Total** |
| 2009-2014 | 0 | 30 | 1 | 31 |
| 2014-2018 | 8 | 5 | 29 | 42 |
| 2018-2023 | 34 | 3 | 3 | 40 |
| Total | 42 | 38 | 33 | 113 |

Table 3: Statistically significant changes in plant density between survey years by region

|  |  |  |  |
| --- | --- | --- | --- |
| Region | Ajara | Guria | Imereti |
| Year period | **Inc** | **Dec** | **No** | **Inc** | **Dec** | **No** | **Inc** | **Dec** | **No** |
| 2009-2014 | 0 | 22 | 0 | 0 | 4 | 0 | 0 | 4 | 1 |
| 2014-2018 | 0 | 4 | 21 | 5 | 1 | 4 | 3 | 0 | 4 |
| 2018-2023 | 24 | 0 | 0 | 7 | 2 | 2 | 3 | 1 | 1 |

Fig 5. Plant density dynamics for individual sites by region in Georgia. Note log10 axis. Error bars have been omitted for brevity.

Fig. 6: Plant abundance dynamics for individual sites by region in Georgia. Note log10 axis. Error bars have been omitted for brevity.

Fig. 7: Mean plant density per site for sites of High, Low, Medium or Medium/High conservation value. Error bars omitted for brevity.

# Discussion

The population trends indicate that the wild Galanthus populations in 2023 were at similar levels to those in 2009, despite the dramatic decrease in counts for many of the sites in the intervening years. This implies that there is no urgent need to adjust the wild bulb harvesting approach based on the recorded population dynamics alone. Though there does appear to be an increased need to understand the causes of the dynamics.

The dominant pattern in population trends over the past 14 years has been a decline then increase in population density and, consequently, abundance across most wild sites, especially in Ajara. The reasons for this decrease are not known and should be explained. The leading hypotheses are:

1. Timing of survey. It has been the case over the years that surveys were conducted early in the season, at a time when not all the population has achieved full emergence. Counts at these times of year would under-estimate abundance because of reduced leaf counts. One initial check of this would be to examine the time of year when surveys were conducted, and possibly to also account for the weather in the preceding months to account for growing conditions leading up to the survey.
2. Different surveyors. It could be the case that different surveyors over the years have different accuracies and approaches to counting plants. This was the case in 2009 when some surveyors were estimating plant abundance directly rather than counting leaves however it is believed that this had been corrected by 2014 and everyone was consistently counting leaves. It is worth checking with the historical surveyors.
3. Harvesting. It could be the case that declines in abundance had been due to harvesting from wild populations. If this were the case, then we would expect harvest intensity to have varied over the period and to have allowed populations to recover between 2018 and 2023. We don’t believe this to be the case, but it is worth checking with the harvesters.
4. Natural variation. It could be the case that something to do with environmental variation caused the *Galanthus woronowii* populations to dramatically fluctuate over the period, e.g. a major drought causing increased mortality and reduced recruitment at the beginning of the period. This explanation seems less plausible but could be investigated using historical weather data.

The patterns of abundance and density do vary across regions and sites and these differences should be investigated further, not least because they may help explain the dominant patterns. For example, many of the newly selected sites in Guria in 2014 show trends that are quite different from the sites originally surveyed in 2009. The incorporation of new sites with quite different population densities and abundances argues for developing a more systematic approach to establishing where wild *Galanthus woronowii* populations are in Georgia.

# Recommendations

1. If surveys are to continue with using leaf counts, then it should be verified that they have achieved full leaf emergence. Studying the dynamics of emergence over a season through multiple site visits and, ideally multiple years, would help to elucidate the phenology of leaf emergence.
2. The reasons for the variation in density and abundance counts should be investigated as a matter of importance because this will inform the extent to which the survey method and the harvest quota setting approach should be refined.
3. Investigations should be conducted into whether a more systematic method to identify *Galanthus woronowii* populations can be developed. For example, species distribution modelling methods could be applied to the existing location data to identify the bioclimatic conditions needed to support wild populations and refined in combination with field surveys to establish how accurately wild sites can be located.
4. Wild site harvests should avoid locations for which there has been a significant decline detected until it is established that the populations have recovered.
5. It’s not advised to increase the bulb harvest quota further.
6. Ideally, inspectors should be present on site where and when the wild populations are harvested, and pre- and post-harvest surveys conducted to help uncover the short and long-term impacts of harvesting.
7. Repeated site surveys should be continued to help establish the dynamics of unharvested and harvested wild populations.
8. Assessments of areas and locations for individual sites still vary year on year. It should be investigated how much of this variation is reducible. The use of more precise site identification and measurement methods (e.g. using satellite data and geospatial analytics) could help to reduce this variation.
9. The overall status of wild and cultivated populations in Georgia continues to have uncertainties that could impact the long-term viability of the wild populations and the bulb trade. A business and conservation-based case should be created to justify a more comprehensive and detailed evaluation of the status of the populations and improvements to survey design and quota setting. Setting up a Georgia based PhD student or PostDoc focussed on these issues seems like a good way to achieve this.
10. A mechanism should be established to ensure the long-term maintenance of the survey data associated with the assessment of *G. woronowii* in Georgia.

# References

McGough, H.N., Kikodze, D., Wilford, R., Garrett, L., Deisadze, G., Jaworska, N. and Smith, M.J., 2014. Assessing non-detrimental trade for a CITES Appendix II-listed plant species: the status of wild and cultivated *Galanthus woronowii* in Georgia. *Oryx*, *48*(3), pp.345-353.