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Collaborative mapping of new localities of *Iris antilibanotica* Dinsm. (Iridaceae) in the Anti-Lebanon Mountains

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Abstract. *Iris antilibanotica* Dinsm. is a narrow endemic species of the Anti-Lebanon Mountains with an incompletely documented distribution. We report a range-wide survey effort of the species with new Lebanese and Syrian localities, including populations near Arsal, Halbon, and Bloudan, recorded with the help of local pastoralists. Plants occurred in remote rocky habitats and anthropogenic edge environments. Grazing caused only limited localized herbivory in Syrian sites, whereas agricultural conversion, stone clearance, orchard establishment, and uprooting were the main observed threats near Arsal. Precise locality information is withheld for conservation reasons.

Keywords. Arsal, Bloudan, Halbon, cherry orchards, local ecological knowledge, rangeland, Red List reassessment

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Introduction

The section *Oncocyclus* (Iridaceae) comprises a monophyletic group of irises distributed across the eastern Mediterranean and Southwest Asia, typically characterised by geographically restricted populations, strong spatial isolation, and high habitat specificity (Volis et al. 2024).

Iris antilibanotica Dinsm. is a Critically Endangered species restricted to the Anti-Lebanon range, characterised by small population sizes, high habitat specificity, and a fragmented and incompletely documented distribution (Lansdown 2016). Previously reported occurrences are concentrated in the central and southwestern Anti-Lebanon, including the Bloudan area in Syria and Khraybet Baalbak in Lebanon (Tohmé and Tohmé 2014; Lansdown 2016; Bou Dagher Kharrat et al. 2021). At the time of assessment, both its area of occupancy (AOO) and extent of occurrence (EOO) were estimated at 4 km^2 based on a single known location. Despite its conservation importance, the species remains poorly documented in the field, and existing occurrence records are sparse, geographically clustered, and often imprecisely georeferenced.

The Anti-Lebanon Mountains form a high-elevation, semi-arid mountain system along the Lebanon–Syria border, characterised by rocky substrates and strong environmental gradients that support localised and often fragmented plant populations. Parts of the Anti-Lebanon border region have historically been undersurveyed due to access constraints, security considerations, and logistical challenges, contributing to gaps in documented species distributions. The help of pastoralists from the local community for targeting surveys, as in the present study, is particularly useful in such a

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challenging environment, and an example on how rangeland conservation can be supported by transdisciplinary research with local populations (Manzano et al. 2021).

For narrow endemic plant species in open mountain systems, incomplete distribution data can influence not only estimates of range size, but also interpretations of threat processes and conservation priorities. The current IUCN Red List assessment identifies grazing as a major inferred threat to *I. antilibanotica* based on its occurrence at a single known locality and the presumed impact of livestock on habitat quality (Lansdown 2016). In semi-arid Mediterranean landscapes, however, disturbances such as livestock grazing and agricultural conversion may operate through fundamentally different ecological pathways. While low-intensity grazing can maintain open habitat structure and reduce woody encroachment (Bond 2019), permanent agricultural conversion may eliminate rocky microhabitats entirely, a process already known to negatively affect rock-associated amphibians and reptiles (Michael et al. 2021; Jithin et al. 2023). Distinguishing these processes is therefore important for evaluating both species persistence and the ecological meaning of recorded threats.

The aims of this study are to document newly identified populations of *I. antilibanotica* in Lebanon and Syria, to reassess lower-bound estimates of its geographic distribution, and to examine how grazing and agricultural conversion differ in their observed impacts across sites.

Methods

Field observations were conducted independently and jointly by the authors across multiple localities in the Anti-Lebanon region between 2024 and 2026, with site identification supported by local ecological knowledge from shepherds. As community liaisons, local shepherds facilitated identifying accessible high-elevation areas, including seminatural rocky habitats considered representative of the surrounding landscape. Surveys focused on visually accessible and non-hazardous terrain within the Jurd (high-elevation open areas above the treeline or in arid conditions). Where anthropic land uses overlapped with the new observed sites, historical imagery available through Google Earth Pro was inspected qualitatively to assess broad land-use changes surrounding occurrence sites.

In both Lebanon and Syria, field surveys were conducted in the plant's flowering period, April and May. In Lebanon, fieldwork targeted the Arsal region of the northern Anti-Lebanon Mountains. In Syria, fieldwork was conducted in the outskirts of Halbon (Jaroud Halbon) and in Bloudan. No voucher specimens were collected because *Iris antilibanotica* was classified as Critically Endangered at the time of the surveys; records were therefore documented photographically or by video to avoid disturbance.

Species identification was based on in situ observation of diagnostic floral characteristics. Geographic coordinates were recorded using handheld GPS devices and later processed for mapping and spatial analysis. Species distribution maps were produced in R v. 4.6.0 (R Core Team 2026) using the packages sf (Pebesma 2018) and ggplot2 (Wickham 2016). Occurrence points were also overlaid with Important Plant Area (IPA) polygons to identify whether newly documented sites fell within recognized plant-conservation areas (Yazbek et al. 2011; Talhouk et al. 2017). Published occurrence records from the literature and Global Biodiversity Information Facility (GBIF) were reviewed and used as approximate reference localities where precise georeferenced coordinates were unavailable. For example, the Khraybet Baalbak locality reported by Bou Dagher Kharrat et al. (2021) was approximated at the settlement level and treated as a proxy for the Lebanese population cluster. Distribution metrics were therefore interpreted conservatively as lower-bound estimates derived primarily from verified field observations combined with approximate literature-based localities. Exact coordinates are reported at reduced precision to minimize the risk of collection, disturbance, or habitat degradation of this narrow endemic species.

To contribute to updating the Red List assessment of the species, we estimated the minimum extent of occurrence (EOO) as defined by the area of the minimum convex polygon enclosing the set of verified occurrence points, and the minimum area of occupancy (AOO), defined as the number of occupied 2 × 2 km grid cells multiplied by 4 km^2, following standard International Union for Conservation of Nature (IUCN) guidelines. Both EOO and AOO were calculated using GeoCAT (Geospatial Conservation Assessment Tool) with a standard 2 × 2 km grid. EOO and AOO calculations were performed using the full-resolution point set without localities where species was established as recently introduced.

Results

***Iris antilibanotica* Dinsm.**

New populations of *Iris antilibanotica* were documented in both Syria and Lebanon, extending the currently documented distribution northwards and revealing persistence across contrasting disturbance contexts.

New records. LEBANON — Baalbek-Hermel Governorate • Arsal, Anti-Lebanon Mountains; 34.10°N, 036.41°E; 2,041 m a.s.l.; 16.V.2024; M. Itani and K. Ezzedine obs.; flowering individuals in uncultivated orchard-edge microhabitat; photographic documentation • Arsal, Anti-Lebanon Mountains; 34.08°N, 036.39°E; 2,134 m a.s.l.; 16.V.2024; M. Itani and K. Ezzedine obs.; flowering individuals in seminatural rocky slope habitat; photographic documentation • Arsal, Anti-Lebanon Mountains; 34.08°N, 036.39°E; 2,134 m a.s.l.; 16.V.2024; M. Itani and K. Ezzedine obs.; flowering individuals in disturbed rocky substrate associated with land preparation for cultivation; photographic documentation.

SYRIA — Rif Dimashq Governorate • Bloudan, Anti-Lebanon Mountains; 33.76°N, 036.16°E; 2,157 m a.s.l.; 22.V.2025; O. Al-Halabi and M. Al-Hourani obs.; flowering individuals near transformed rocky site; photographic documentation • Halbon, Anti-Lebanon Mountains; 33.77°N, 036.22°E; 2,145 m a.s.l.; 24.V.2025; O. Al-Halabi and M. Al-Hourani obs.; flowering individuals in seminatural rocky habitat; photographic documentation • Halbon, Anti-Lebanon Mountains; 33.80°N, 036.23°E; 2,252 m a.s.l.; 24.V.2025; O. Al-Halabi and M. Al-Hourani obs.; flowering individuals in seminatural rocky habitat; photographic documentation • Halbon, Anti-Lebanon Mountains; 33.78°N, 036.22°E; 2,174 m a.s.l.; 24.V.2025; O. Al-Halabi and M. Al-Hourani obs.; flowering individuals in grazed rocky habitat with limited herbivory; photographic documentation.

LEBANON/SYRIA — Lebanon–Syria Border area near El Harf border crossing • 33.83°N, 036.23°E; 2,151 m a.s.l.; 02.VI.2026; M. Al-Hourani obs.; flowering individuals in seminatural rocky habitat; video documentation.

Identification. Plants were identified as *I. antilibanotica* based on flowering morphology and locality. Following Mouterde's (1966: 306–308) key to *Oncocyclus* irises, the plants had large flowers with hairy outer tepals, yellowish hairs or beard toward the tepal base, and predominantly purple perianths. The observed flowers were reddish-purple, whitish toward the base, with an ample perianth, matching the diagnostic treatment of *I. antilibanotica* from the Anti-Lebanon.

Observations. In Bloudan, Syria, *Iris antilibanotica* persisted in uncultivatable rocky outcrops in proximity to orchards (Figure 1). In Halbon, populations occurred across relatively intact open rocky slopes with sparse vegetation cover, where *I. antilibanotica* formed scattered to locally dense flowering patches within heavily grazed semi-arid rangeland. At more accessible sites, *I. antilibanotica* often co-occurred with species such as *Onobrychis cornuta* (L.) Desv., *Ferula hermonis* Bois., and *Astragalus* spp.

In Arsal, Lebanon, the population was found across a mosaic landscape comprising seminatural rocky slopes and actively cultivated agricultural land. Individuals occurred not only in open rocky steppe habitats, but also in uncultivated stony margins and hedgerow-like strips between newly

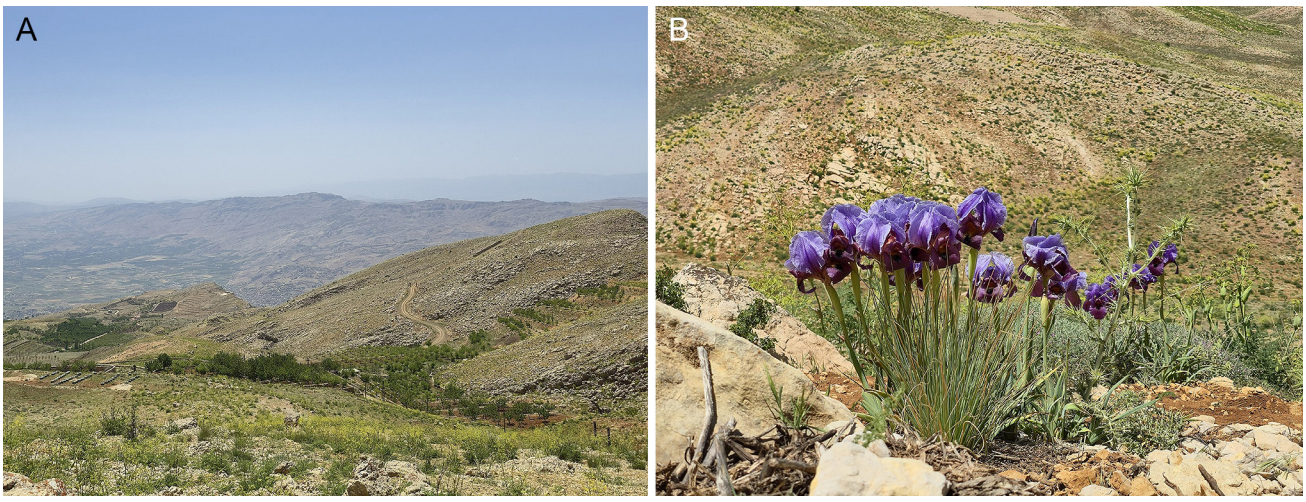

Figure 1. Iris antilibanotica in Syrian Anti-Lebanon habitats. **A.** Flowering clump in grazed open rocky habitat. **B.** Perspective from rocky outcrops hosting local population near expanding orchards in Bloudan.

Figure 2. *Iris antilibanotica* across contrasting habitat contexts near Arsal, Anti-Lebanon, 16 May 2024. **A.** Clumps in open seminatural rocky slope habitat patches, near expanding cherry orchards. **B.** Flowering clumps in remnant uncultivated margins adjacent to established cherry orchards. These images illustrate persistence across a gradient of anthropogenic disturbance, from relatively intact rocky steppe to edge habitats embedded within an agricultural matrix.

established cherry orchards. These edge habitats included both residual rocky patches that had not yet been cleared or levelled for cultivation and margins formed by excavated rocky material displaced during orchard establishment (Figure 2). The surrounding area showed clear evidence of recent agricultural transformation, particularly cherry orchard establishment, while local reports indicated that prior land use was predominantly open rangeland.

Occurrence data availability and lower-bound distribution estimates. Publicly available occurrence data for *I. antilibanotica* are extremely sparse and largely unsuitable for spatial analysis, consisting mainly of historical herbarium records and database-linked sequence entries (GBIF 2026). These records lack precise georeferenced coordinates, rendering them inadequate for direct estimation of distribution metrics such as EOO and AOO. Newly documented occurrences extend the previously reported distribution northwards (Figure 3; Table 1). The Arsal occurrence rows fall within the Aarsal Important Plant Area (IPA LB003), a high-elevation site spanning approximately 1,300–2,500 m a.s.l. (Plantlife International 2026).

Estimates derived from the expanded occurrence dataset were EOO ≈ 338 km^2 and AOO = 40 km^2 (Table 2). These values exceed the spatial thresholds for Critically Endangered status under Criterion B (EOO < 100 km^2; AOO < 10 km^2) (IUCN 2012), although the species remains highly range-restricted. The locally verified border occurrence was documented by video material showing flowering clumps and mapped using approximate GPS information. Because this locality lies within the convex hull formed by the other wild and literature-based occurrences, its inclusion increased AOO by one 2 × 2 km grid cell (4 km^2) but did not alter EOO.

Observed threats. In remote rocky localities documented in Syria, grazing was the main visible pressure. Minor leaf- and occasional flower-level herbivory was recorded at one site in Halbon, where nibbling affected two clumps out of at least 10 observed clumps (Figure 4). Damage was mostly limited to leaf tissue, although three fully grazed flowers and minor petal damage on one open flower were also observed. No clear reduction in overall plant vigour or flowering success was observed at the population level.

In Arsal, the main observed disturbance was agricultural land conversion, especially the expansion of cherry orchards. Recently established cherry orchards, stone piles from land preparation, cleared substrate, and uprooted clumps of *I. antilibanotica* were observed (Figure 4). Visual inspection of historical satellite imagery available through Google Earth Pro suggests that cherry orchard cover near the newly documented locality is relatively recent, with little evidence of such land use prior to the early 2000s. A quarry was visible on the horizon, indicating additional anthropogenic pressures at the landscape scale. In these orchard systems, individuals were consistently absent from established orchard interiors and were recorded only in remnant microhabitats, including hedgerow-like margins, stony strips, and recently disturbed or uncleared rocky patches.

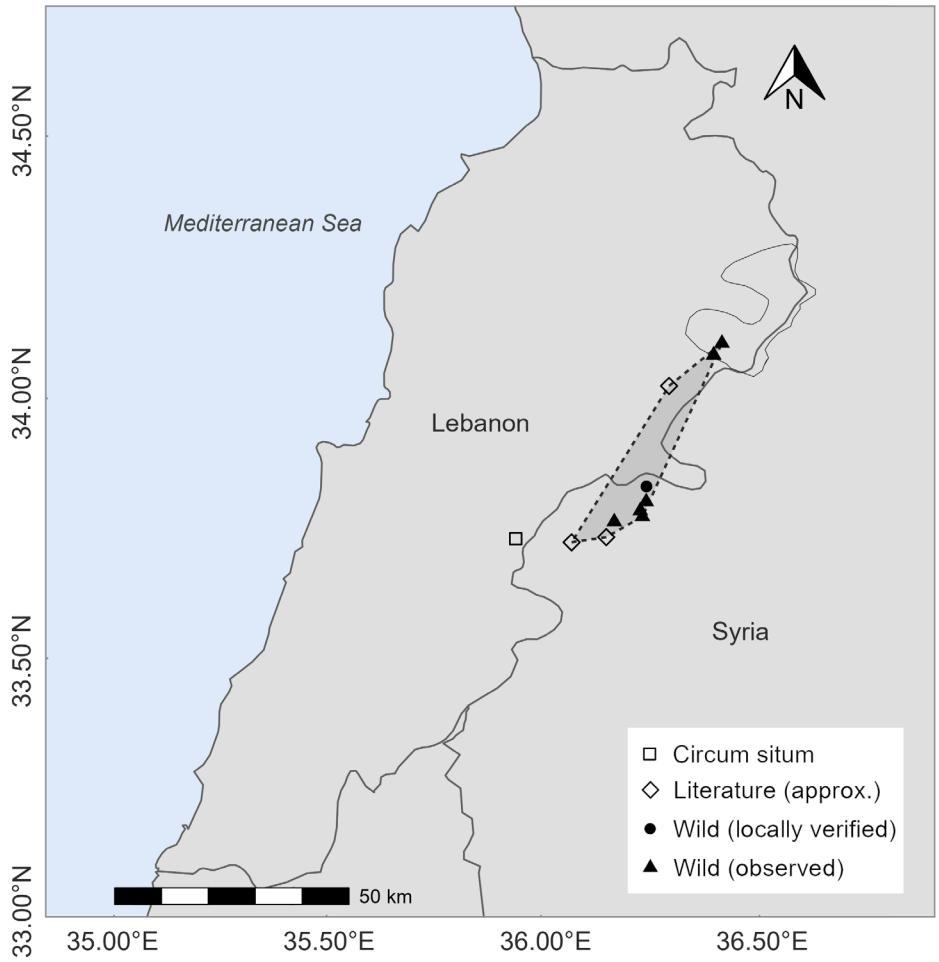

Figure 3. Iris antilibanotica occurrences in Lebanese and Syrian Anti-Lebanon localities. The dashed polygon corresponds to the convex hull enclosing wild and literature-based occurrences and represents a lower-bound estimate of extent of occurrence (EOO). The locally verified wild occurrence was documented by video material showing flowering clumps. The circum situm site is shown for context only and is excluded from EOO and area of occupancy (AOO) calculations. Thin grey polygon outlines indicate Important Plant Areas overlapping at least one mapped occurrence point; the Arsal records fall within the Aarsal IPA (LB003).

Table 1. Verified occurrence points of Iris antilibanotica. LB = Lebanon; SY = Syria. Coordinates are rounded to two decimal places. "Context" refers to the dominant local disturbance or land-use condition observed in the field. Records P2 and P3 share the same rounded coordinate position and are shown as a single mapped point in Figure 3. AOO calculations were performed using the full-resolution point set and literature-derived localities, not the rounded coordinates shown here. Population size spans follow IUCN (2012). Priority conservation sites are highlighted in bold.

ID	Locality	Latitude	Longitude	Elevation (m) a.s.l.	Context / habitat	Population size
P1	Arsal, LB	34.10	036.41	2,041	Orchard edge	A (<10)
P2	**Arsal, LB**	**34.08**	**036.39**	**2,134**	**Undisturbed patches**	**C (26–50)**
P3	Arsal, LB	34.08	036.39	2,134	Transformed site (land preparation)	B (11-25)
P4	**Bloudan, SY**	**33.76**	**036.16**	**2,157**	**Near transformed site**	**E (101–1001)**
P5	Halbon, SY	33.77	036.22	2,145	Undisturbed patches	A (<10)
P6	Halbon, SY	33.80	036.23	2,252	Undisturbed patches	C (26 - 50)
P7	Halbon, SY	33.78	036.22	2,174	Undisturbed patches (low herbivory)	C (26 - 50)
P8	Border area, LB–SY, near El Harf border crossing	33.83	036.23	2,151	Undisturbed patches	C (26 - 50)

Discussion

These observations expand the documented distribution of *Iris antilibanotica* and show that current knowledge of the species remains incomplete. The newly documented populations also demonstrate that suitable habitat remains undersurveyed in parts of the Anti-Lebanon, suggesting that additional occurrences may yet be discovered through targeted fieldwork. The verified and literature-derived occurrences form a predominantly north–south distribution along the Anti-Lebanon mountain range, with the newly documented northern population extending the previously known range. Although it has been suggested that Lebanese populations may have been introduced from Syria through

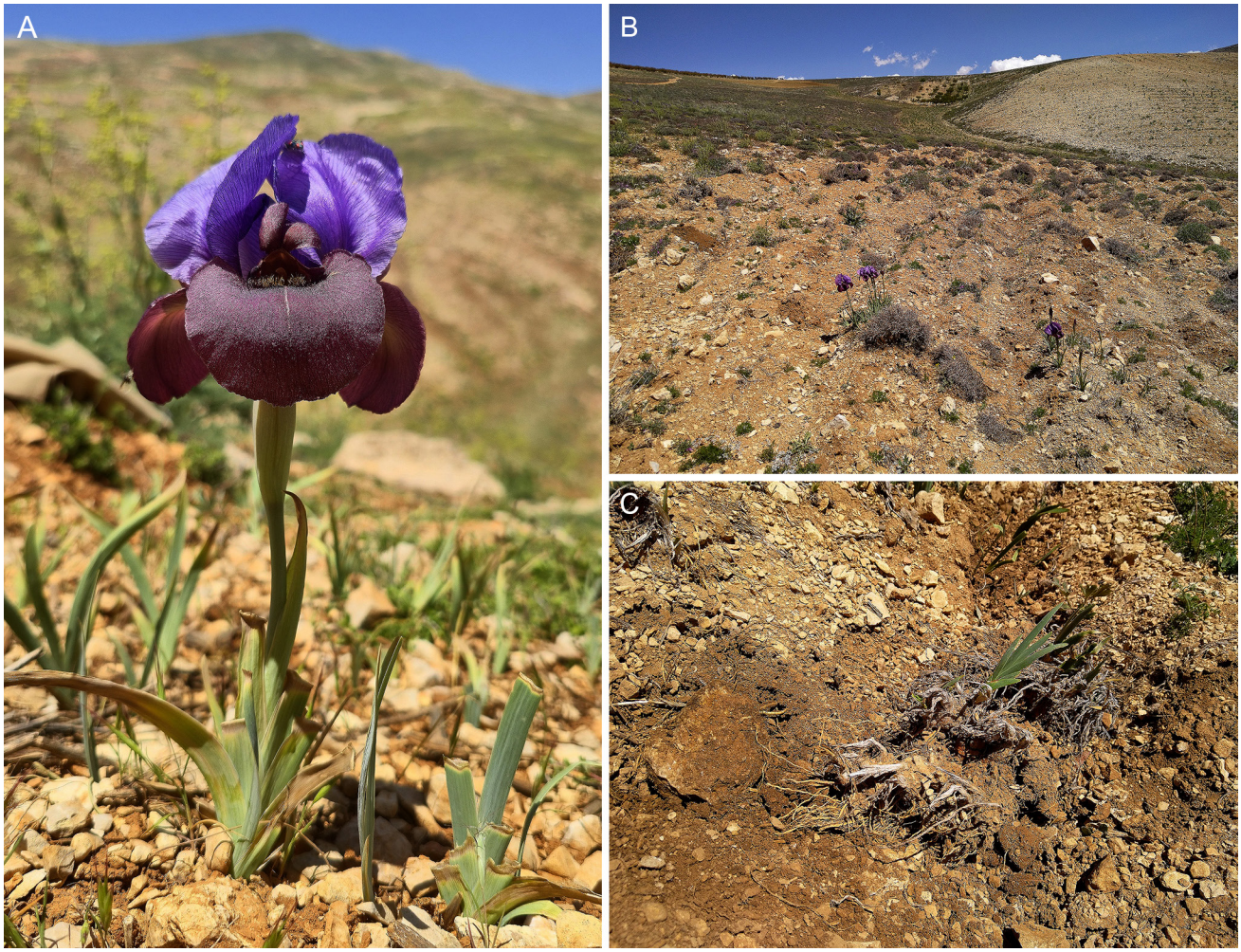

Figure 4. Observed disturbances affecting Iris antilibanotica. **A.** Limited herbivory in grazed habitat in Halbon, Syria; damage was localized and primarily restricted to leaf tissue. **B.** Flowering clump persisting within a recently excavated area near Arsal, Lebanon, during the first year after land-preparation disturbance. **C.** Partially desiccated rhizomes following land preparation for orchard establishment near Arsal.

Table 2. Comparison of lower-bound EOO and AOO estimates under different occurrence datasets.*

Dataset	EOO (km²)	AOO (km²)
Red List (single location estimate)	4	4
Red List + Khraybet Baalbak (Lebanon)	≈112	12
Field + literature-derived points (Syria + Lebanon)	≈338	40

*When extent of occurrence (EOO) is extremely small, often corresponding to a single known location, EOO and area of occupancy (AOO) may converge to similar minimal values. In such cases, EOO provides limited additional information for assessment under IUCN Criterion B, and classification depends primarily on the associated subcriteria (e.g. number of locations, continuing decline, or threats). The low EOO value for the Lebanon-only dataset reflects the near-linear spatial arrangement of points, which produces the required convex hull for EOO estimation.

human-mediated planting (Depalle 2022), this interpretation likely does not apply uniformly across all localities. While such a scenario cannot be excluded for sites such as Khraybet Baalbek, the Arsal population is more plausibly interpreted as naturally occurring, given its occurrence across seminatural rocky habitats and minimally modified margins, rather than confined to planted or managed settings. The new observations also matter directly for conservation assessment because the current Critically Endangered classification was based on extremely limited spatial data, with EOO and AOO both estimated at 4 km² (Lansdown 2016). Our revised estimates should not be interpreted as a formal reassessment, but they show that field-based occurrence data can materially alter the spatial basis of Criterion B evaluation. While the updated lower-bound estimates remain within thresholds consistent with Endangered status, a formal reassessment would require evaluation of additional IUCN subcriteria, including the number of locations, continuing decline, and the severity of threats. Accordingly, the present results should be interpreted as evidence that spatial under-sampling may have led to an

underestimation of distribution extent, rather than as a definitive reassignment of conservation status. More broadly, the extreme sparsity of georeferenced data for *I. antilibanotica* highlights how conservation assessments based on limited occurrence records may oversimplify the true spatial structure and ecological context of narrow endemic species.

The observations also refine the interpretation of threats. The current Red List account identifies grazing as a major inferred threat (Lansdown 2016), but our field observations suggest that threat exposure is spatially heterogeneous. In remote rocky Syrian localities, grazing was the main visible pressure, but damage was localised and limited. This pattern is consistent with variable palatability reported among species of the genus *Iris*, with some species being avoided by herbivores while others are grazed depending on ecological context (Bossuyt et al. 2005; Conover et al. 2018). Because *I. antilibanotica* has not been chemically profiled, however, we avoid inferring toxicity or specific deterrent compounds for this species. In contrast, at Arsal, agricultural conversion produced direct habitat loss through stone clearance, orchard establishment, substrate disturbance, and uprooting of plants. This distinction is important because visible grazing pressure does not necessarily imply population-level decline, whereas land conversion can remove occupied microhabitats rapidly and irreversibly. Stone removal, previously reported as a potential threat consideration for herpetofauna (Michael et al. 2021; Jithin et al. 2023), is therefore also a threat for plant species.

This case therefore illustrates a broader challenge in conservation assessments of open and semi-arid systems. Grazing and herbivory are often treated as inherently negative disturbances, yet open ecosystems may be partly maintained by consumers such as herbivores and fire, which can limit woody encroachment, sustain light-demanding species, and maintain habitat heterogeneity (Bond 2019; Pausas and Bond 2020). In Mediterranean landscapes, livestock grazing can likewise function as a management tool when intensity, timing, and mobility are compatible with ecosystem dynamics (Perevolotsky and Seligman 1998; Oikonomou et al. 2023; Ribeiro et al. 2023). For *I. antilibanotica*, the available evidence does not support treating grazing as the dominant threat across all sites. Instead, the observations suggest that grazing and agricultural conversion operate through fundamentally different ecological pathways: grazing may structure plant communities in ways that allow persistence within open habitats, whereas agricultural expansion results in the direct removal and transformation of those habitats.

The expansion of rainfed cherry orchards in the Anti-Lebanon has previously been described as a low-input and potentially sustainable agricultural alternative in marginal highland systems (Talhouk et al. 1996). Our observations do not contradict this at the agricultural-system scale but show that such transitions can still produce localised losses for narrow-endemic plants occupying rocky microhabitats. In Arsal, *I. antilibanotica* persisted in margins, stony strips, and recently disturbed patches, but was absent from established orchard interiors. This pattern suggests edge-mediated, short-term persistence rather than stable resilience. Similar dynamics are consistent with delayed local extirpation or extinction debt, where remnant individuals persist temporarily after habitat transformation while recruitment and long-term viability decline (Kuussaari et al. 2009; Hylander and Ehrlén 2013; Santos et al. 2025).

The likely mechanisms are multiple. Mechanical land preparation can directly uproot plants or bury suitable substrate. Repeated tillage, mowing, pruning-associated clearing, and harvesting can impose chronic disturbance on perennial geophytes and rhizomatous species. Orchard establishment may also increase shading and alter below-ground moisture regimes. Because *Oncocyclus* irises are adapted to xeric seasonal conditions and are reported in cultivation to be sensitive to excess moisture during summer dormancy (Depalle 2022), irrigation may represent an additional exclusion mechanism in orchard systems. This interpretation is consistent with field observations from Sicily, where *I. planifolia* persists mainly in uncultivated margins and rocky refugia but is reduced within cultivated orchard interiors (D. Pacifico pers. comm. 2026).

These findings have practical implications. Conservation action should not focus only on excluding grazing, especially where grazing damage is limited and where pastoralists help locate and monitor populations. Instead, management should distinguish low-intensity disturbance from acute habitat conversion. At agricultural frontiers, recently excavated or partially cleared plots may provide a narrow window for conservation action, including carefully permitted translocation to nearby suitable rocky refugia.

This pattern also reflects a broader land-use dynamic in the Anti-Lebanon, where pastoralism and crop agriculture operate as competing systems with contrasting spatial and ecological logics. Mobile grazing systems rely on access to extensive rangelands and are often compatible with rocky and marginal habitats, whereas agricultural expansion involves permanent land conversion, enclosure, and

substrate modification. In Lebanon, the expansion of agriculture and agro-pastoral intensification has been associated with a reduction in pastoral mobility and a shift toward more sedentary production systems, accompanied by declining use of rangelands (Sattout 2014). In this context, continued pastoral use may help maintain land in an open, non-converted state, whereas the weakening of mobile grazing systems can make rangelands more vulnerable to enclosure, cultivation, or other fixed land uses.

For narrow endemic species such as *I. antilibanotica*, this distinction is critical: low-intensity grazing may be compatible with persistence, whereas the transition to permanent agriculture results in the loss of suitable habitat. Treating these land uses as equivalent disturbances therefore risks obscuring fundamentally different ecological consequences.

Finally, the study highlights the value of local ecological knowledge in undersurveyed mountain systems. Shepherds and field companions facilitated access to remote habitats and contributed directly to the discovery of populations that might otherwise have remained undocumented. Similar interview- and community-supported approaches have generated reliable information on elusive and poorly documented species elsewhere, while also showing that local knowledge varies among social groups and should be interpreted contextually (Turvey et al. 2014). In the Anti-Lebanon, such knowledge is not a substitute for botanical verification, but it is an essential pathway for finding rare taxa in difficult, insecure, and logistically constrained landscapes. More broadly, the study illustrates how field-based documentation of narrow endemic species can refine both distributional knowledge and the interpretation of ecological threats in open mountain ecosystems undergoing rapid land-use change.

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Additional information

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

Use of artificial intelligence (AI)

The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI. Microsoft Copilot and ChatGPT were used in the preparation of the manuscript.

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Author contributions

Omar Al-Halabi and Moustapha Itani contributed equally to this work. Conceptualization: MI. Data curation: OAH, MI. Investigation: OAH, MI, MAH, KE, MS, PM. Methodology: OAH, MI. Supervision: PM. Visualization: OAH, MI. Software: MI. Validation: MS. Writing – original draft: MI, OAH. Writing – review and editing: MI, OAH, MS, PM.

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Data availability

All data that support the findings of this study are available in the main text. Precise locality information is withheld to reduce the risk of disturbance, collection, or further habitat degradation.

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