IUCN Red List Assessment of the Flora of the State of Palestine (West Bank): Towards a National Strategy for Plant Biodiversity Conservation

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Abstract

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This study presents the Red List of vascular plants for the Palestinian West Bank, assessing the threat status of native vascular taxa, following the latest categories, criteria, and application guidelines of the International Union for the Conservation of Nature (IUCN). Vascular plants introduced after 1900 (neophytes) are excluded from this assessment. The analysis is based on records up to December 2024, sourced from the biodiversity databases (BERC, BIOGIS, and GBIF databases) herbarium label, published literature, and BREC field surveys. Since the last publication of the Red Lists of Palestine – Vascular Plants more than two decades ago, significant economic, social, and cultural changes have impacted the distribution, extent, and quality of the semi-natural and other habitats supporting native vascular plants in Palestine. Concurrently, there has been an ample increase in the recording and study of Palestinian vascular plants at multiple scales, including 2 km x 2 km grid squares, specific sites, and population levels. These enhanced datasets have been fully utilized for the current Red List assessments. In total, 1,741 taxa native to the Palestinian West Bank were assessed. Of these, 482 taxa (27.69%) were categorized under IUCN Red List threat categories: Critically Endangered (CR) 94 taxa (5.40%), Endangered (EN) 170 taxa (9.76%), and Vulnerable (VU) 218 taxa (12.52%), comprising the Red-listed taxa for the Palestinian West Bank. Additionally, 401 taxa (23.03%) were classified as Near Threatened (NT), while 710 taxa (40.78%) were assessed as Least Concern (LC) and 121 taxa (6.95%) were data deficient (DD). Notably, 27 species were categorized as Extinct (EX), as they are only known from type specimens collected in the previous century.
These findings underscore the urgent need for conservation measures and represent the most comprehensive Red Data List of native vascular plants for the West Bank to date, serving as a vital tool for identifying and protecting threatened flora at both national and global levels.

INTRODUCTION

The State of Palestine (SP), comprising the West Bank and Gaza Strip, is a crucial reservoir of biodiversity within the Mediterranean region. The region is home to approximately 1,826 plant taxa spanning 686 genera and 108 families (Ali-Shtayeh et al., 2022a). With a density of 1,826 taxa per 6,286 square kilometers, SP ranks among the most biologically diverse areas in the region (Danin, 1988). This diversity is attributed to Palestine's unique geographic position as a biogeographical land bridge connecting Europe and Africa, as well as its varied topography, geology, and climate. Combining diverse soil types and microclimates further enhances species diversity and endemism. Additionally, historical human intervention has significantly shaped the region's flora (Shtayeh & Hamad, 1993).

Despite its rich biodiversity, Palestine's flora is increasingly threatened by anthropogenic activities, including agricultural expansion, deep plowing, pesticide use, overgrazing, urbanization, and tourism (Ali-Shtayeh et al., 2022a). Global factors such as climate change, drought, water stress, and pollution further exacerbate these threats. The urgency of these challenges underscores the need for robust conservation strategies to protect Palestine's plant species.

In response to these threats, efforts have been directed toward compiling a Red List of threatened vascular plant taxa in Palestine (Ali-Shtayeh & Jamous, 2002; Ali-Shtayeh & Jamous, 2018). The National Red List is a fundamental tool for conservation, research, and policymaking, especially concerning endemic and threatened species. The first Palestinian Red List was compiled in the early 2000s (Ali-Shtayeh & Jamous, 2002), aligning with global conservation efforts initiated by the International Union for Conservation of Nature (IUCN) in the late 1960s.

Since the initial Red List, many plant species in Palestine have become increasingly threatened due to both local human activities and global environmental changes. A second version of the national Red List was compiled in 2018, incorporating updated plant records and rectifying previous errors (Ali-Shtayeh et al., 2018). This updated assessment identified 102 threatened taxa and provided conservation recommendations based on species taxonomy, distribution, population size, ecological requirements, and threats. The assessment utilized a modified "Red Number" procedure, applying six quantitative criteria: rarity, habitat vulnerability, attractiveness, distribution type (endemism), disjunctiveness, and peripherality to determine extinction risk (Sapir et al., 2003; Ali-Shtayeh et al., 2018).

The 2018 assessment revealed that 76.4% of threatened Palestinian species face a high risk of extinction. Among them, 39.2% were classified as critically endangered (CR), 37.2% as endangered (EN), and 19.6% as vulnerable (VU). This updated Red List serves as a critical resource for national conservation efforts and public awareness campaigns.

Since the publication of the second Red List, substantial new data on Palestinian flora have been collected, in addition to the IUCN Red List system has undergone significant refinement (IUCN, 2022, 2024a), necessitating further analysis. This study aims to red list all native flora in Palestine using IUCN criteria V.4 to assess their extinction risks

accurately. The IUCN Red List, recognized as the global standard for extinction risk assessments (Hoffmann et al., 2008), plays a crucial role in guiding conservation policies, establishing protected areas, and prioritizing biodiversity hotspots (Possingham et al., 2002; Miller et al., 2007; Hoffmann et al., 2008).

The Red List assessment provides critical insights into species at risk of extinction and helps identify necessary conservation measures. Its results contribute to evaluating habitat conservation status, selecting sites for protection, and identifying taxa in need of urgent conservation efforts.

Conservation status assessments are essential in addressing the biodiversity crisis of the Anthropocene. They provide critical scientific evidence for conservation planning, policy development, and resource allocation while raising awareness about the unprecedented decline in biodiversity (Le Breton et al., 2019; Nic Lughadha et al., 2020). Despite its limitations (Hayward et al., 2015), the IUCN Red List remains the most widely accepted and applied framework for species-level conservation assessments (Rodrigues et al., 2006). The IUCN methodology relies on five primary criteria: population decline (Criteria A and E), population size and distribution (Criteria C and D), and geographic range (Criteria B and D2), with Criterion B being the most frequently applied in global assessments (Le Breton et al., 2019). Species are categorized into extinction risk levels, including extinct (EX), extinct in the wild (EW), critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC), and data deficient (DD). CR, EN, and VU species are classified as threatened with extinction.

Globally, only a small fraction of known species has been evaluated, with 142,577 assessments completed by 2021. Of these, approximately 28% are at risk of extinction (IUCN, 2021). While vertebrates dominate these assessments (77% of known species evaluated), plants remain significantly under-assessed, with only 14% of assessed species (IUCN, 2021). Despite their crucial ecological roles, plant extinctions occur at a relatively slow rate, with 1.26 species per year (Le Roux et al., 2019), but an estimated 39% of vascular plants face extinction due to land-use changes (Nic Lughadha et al., 2020).

Recognizing the fundamental importance of plants to global biodiversity, the Convention on Biological Diversity (CBD) established the Global Strategy for Plant Conservation (GSPC) in 2010 to halt plant biodiversity loss (CBD, 2010). Among its 16 targets, Target 2 calls for a comprehensive assessment of the conservation status of all known plant species to inform conservation actions.

This research aims to support the prioritization of conservation assessments for Palestine's native flora, contributing to the country's efforts to meet GSPC Target 2. It also seeks to identify biodiversity hotspots, unsampled regions, and potentially threatened species to enhance conservation strategies. This publication presents the first comprehensive IUCN Red List assessment of vascular plants native to the Palestinian West Bank, filling a critical knowledge gap and providing a foundation for future conservation efforts at both national and global levels.

STUDY AREA

The Palestinian West Bank (Pal-WB) as the main part of the State of Palestine (SP) is located within historic Palestine, with a total area of 5660 km^2. The geographical coordinates of the West Bank are 31.9466° N, 35.3027° E. Despite its relatively small size, Pal-WB is characterized by a remarkable diversity in topography, climate, phytogeographical regions, vegetation diversity, ecosystems, and habitat diversity (Zohary, 1972; Feinbrun-Dothan, 1978, 1986; Olsvig-Whittaker et al., 2006; Danin, 1988; Shtayeh & Hamad, 1995b; Médail & Quézel, 2022; Zohary, 1966; Rotem & Weil, 2014; Ali-Shtayeh et al., 2022b; Ali-Shtayeh et al., 2025).

MATERIALS AND METHODS

Data Sources

Taxonomic data were verified using several sources, including previous floras and scientific publications (Table 1). Resources consulted include the works of Post (1932, 1933), Zohary (1966, 1972), Feinbrun-Dothan (1978, 1986), Govaerts (1995, 1996, 1999), Plitmann et al., 1999; Al-Eisawi (1998, 2013), and others (Ali-Shtayeh & Jamous, 2018; Ali-Shtayeh et al., 2022a). Additionally, an exhaustive review of online databases and search engines such as Web of Science, Scopus, and Google Scholar was conducted to check for recent taxonomic revisions and new species descriptions. Local herbaria, including the BERC Herbarium, were also consulted.

Distribution data were derived from three sources: 1. Field surveys conducted across various floristic regions of Palestine; 2. Records of wild populations from existing literature and major taxonomic databases (Table 1); and 3. Herbarium specimens were examined at major herbaria (e.g., BERC Herbarium). Distribution maps were created based on the phytogeographical divisions of Olsvig-Whittaker et al. (2006). The extent of occurrence (EOO) and area of occupancy (AOO) were calculated using GeoCAT software (Bachman et al., 2011), following IUCN guidelines (IUCN, 2001).

Table 1. Global databases used as distribution data sources of natural plants in the State of Palestine (SP).

Database	Link
Global Biodiversity Information Facility (GBIF)	http://www.gbif.org/occurrence
International Plant Names Index (IPNI)	http://www.ipni.org
JSTOR Global Plants	http://plants.jstor.org
Plants of the World Online (POWO)	http://www.plantsoftheworldonline.org
World Flora Online (WFO)	http://www.worldfloraonline.org
Lebanon Flora	http://www.lebanon-flora.org/
Flora of Israel online	https://flora.org.il/en/plants/

Data on habitats and ecological requirements were obtained from field observations, scientific literature, and herbarium labels. Climate data were sourced from local meteorological offices and the WorldClim v1.4 database. Elevation range was considered an important factor, as species with narrow

elevation ranges are more vulnerable to habitat loss and climate change.

Information on the economic and medicinal uses of species by local communities, as well as local names, was collected from fieldwork and existing literature (e.g., Ali-Shtayeh et al., 2018 a, Ali-Shtayeh et al., 2018b, Ali-Shtayeh & Jamous 2018, Ali-Shtayeh et al., 2015, Ali-Shtayeh, & Jamous 2006, Ali-Shtayeh et al. 2000, Ali-Shtayeh et al. 2020, Ali-Shtayeh et al. 2013, Ali-Shtayeh & Jamous, 2008). The TAPHM (florapal.org; Ali-Shtayeh & Jamous, 2008; Ali-Shtayeh et al., 2008) database was also consulted for additional information on plant uses.

Threats to species were identified through field observations, consultations with collectors and local experts, and existing literature. This included an analysis of species rarity, biological traits, and floristic region data (IUCN, 2019).

Species distribution maps were created using GeoCAT software, based on latitude and longitude data from field surveys and herbarium records. Additionally, maps highlighting floristic divisions and the Mediterranean Basin Biodiversity Hotspot boundary were included, following guidelines from Plan Bleu (2009).

Red Listing and Conservation Assessments of the Native Flora of Palestine

The following comprehensive methodology was employed to conduct the Red Listing and conservation assessments of the native flora of Palestine. The assessments were conducted in a structured three-step process, distinct from establishing conservation priorities. In the first step, we identified the taxa and regional populations to be assessed. Next, in step two, the regional population of each taxon was evaluated according to the IUCN Categories and Criteria, and a preliminary category of threat was assigned. In the final step, the influence of populations of the same taxon in neighboring regions was considered, and the preliminary category was adjusted, either up- or downlisted, if necessary.

Step 1-Identification of Taxa and Regional Populations to be Assessed (Preliminary Species List): A preliminary species List for conducting IUCN Red Listing and conservation assessments of the native flora in the Palestinian West Bank was created. It consists of data compilation, taxonomic verification, and quality checks. Starting from an annotated checklist of Palestinian vascular flora native to the State of Palestine (https://bdj.pensoft.net/article/80427/) (Ali-Shtayeh et al., 2022a), the nomenclature of specific and subspecific taxa was updated and critically checked according to more recent studies. Additional native taxa were identified from various published sources, amongst others, and these were added to the Red List for assessment or noted there, as appropriate (please see the Palestine Red List No. 3 Native Vascular Plants). In addition, numerous protologues and the following taxonomic databases were consulted: IPNI (2018 onwards), and The World Flora Online Plant List www.worldfloraonline.org (previously the Plant List) (2018 onwards). The systematic order and taxonomic circumscription of the families follow the classification proposed by PPG I (2016) for ferns and fern allies, by Christenhusz et al. (2011) for gymnosperms and by APG IV (2016) for angiosperms. The author's citations of plant names were standardized according to IPNI (2015 onwards). The final checklist of taxa compiled for Red List assessment included 1741 species, and subspecies.

Step 2- Preliminary Assessment and Distribution Mapping: An initial assessment and mapping of the distribution range of the targeted species were conducted utilizing existing scientific literature, databases, and herbarium specimen label data. The native Palestinian flora was assessed following the IUCN criteria and categories (IUCN, 2001), providing supporting documentation, justification, and distribution maps for each species.

Step 3- Final National Assessment: Given the small geographic size of the Palestinian West Bank and its interconnected ecosystems, careful consideration was required when interpreting the potential effects of populations outside the region on the assessed taxa. The limited size of Palestine, combined with its diverse ecological zones and proximity to neighboring regions, meant that conspecific populations beyond its borders could influence species in Palestine. Consequently, certain taxa benefited from a "rescue effect" due to immigration from neighboring populations, leading to the downlisting of their threat status. Conversely, some isolated populations within the country faced heightened extinction risks, warranting an uplisting of their threat category.

Considering the wide range of circumstances encountered in assessing different taxonomic groups across Palestine, strict adherence to every aspect of the IUCN guidelines was sometimes challenging. Given the complexity of the regional context, variability in interpreting certain definitions and applying the guidelines was expected.

All decisions related to category changes, including up- or downlisting, were thoroughly documented, along with the rationale behind each decision. Maintaining consistency across taxa when modifying categories and providing detailed documentation of the decision-making process was critical.

Application of the IUCN Guidelines

We strictly adhered to the IUCN Red List Categories and Criteria (Version 3.1) for the Red Listing of native vascular plant species, without deviation or modification (IUCN, 2012).

IUCN Categories

The IUCN Red List system comprises nine categories (Figure 1), which are divided into two main groups: evaluated and not evaluated species. The evaluated species group is further divided into two subgroups: data-deficient species [DD] and species with adequate data. Species with adequate data are categorized as either non-threatened (Least Concern [LC], Near Threatened [NT]) or threatened (Vulnerable [VU], Endangered [EN], Critically Endangered [CR], and Extinct [EX]).

Extinct (EX): A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), have failed to record an individual throughout its historic range. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Extinct in the Wild (EW). A taxon is Extinct in the Wild when it is known to survive only in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitats, at appropriate times (diurnal, seasonal, annual), throughout its

range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Critically Endangered (CR). A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered. Therefore, it is facing an extremely high risk of extinction in the wild.

Endangered (EN). A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

Vulnerable (VU). A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable. Therefore, it is considered to face a high risk of extinction in the wild.

Near Threatened (NT). A taxon is Near Threatened when evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category soon.

Least Concern (LC). A taxon is Least Concern when evaluated against the criteria and does not qualify as Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in the category.

Data Deficient (DD). A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology is well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data is available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period has elapsed since the last record of the taxon, threatened status may well be justified.

Not Evaluated (NE). A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

IUCN Criteria

Five quantitative criteria (Table 2) were used to determine whether a taxon is threatened, and if so, which category of a threat belongs to Critically Endangered (CR), Endangered (EN), or Vulnerable (VU). These criteria are based on biological indicators of extinction risk, such as rapid population decline or very small population size. Most criteria include subcriteria to specifically justify a taxon's listing under a particular threat category. For instance, a taxon listed as "Vulnerable C2a(i)" is classified as Vulnerable due to having fewer than 10,000 mature individuals (Criterion C) and a declining population where all mature individuals are concentrated in one subpopulation (subcriterion a(i) of Criterion C2).

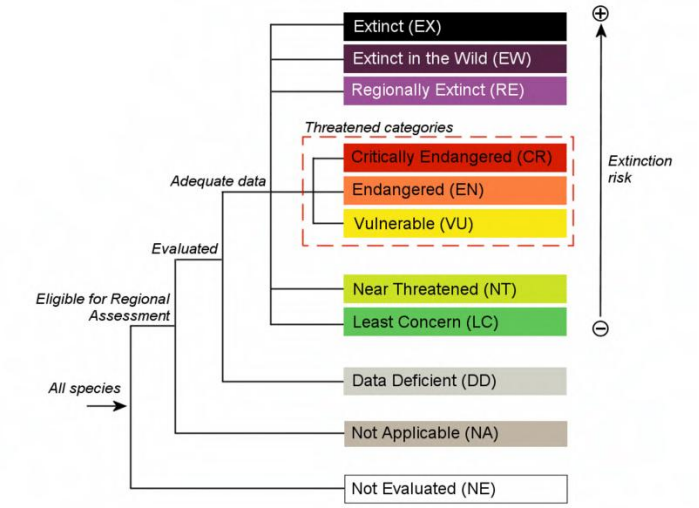

Figure 1. Structure of the International Union for Conservation of Nature (IUCN) categories (IUCN, 2001).

For a taxon to be listed in any threat category, it needs to meet at least one of the criteria (A, B, C, D, or E). However, each taxon is evaluated against as many criteria as the available data allows, and the listing is annotated with all applicable criteria for the specific threat category. For example, a taxon categorized as CR might be listed as "CR: A2cd, B1+2de, C2a(i)." In this instance, only the highest threat category is noted. Suppose a taxon qualifies for multiple criteria in both the VU and EN categories but only meets one criterion for CR. In that case, only the latter criterion is reported (i.e., the highest level of threat). Any additional criteria relevant to lower threat categories are included in the supporting documentation.

Although the criteria for each threat category are based on quantitative thresholds, the system allows flexibility to account for taxa with limited data. In such cases, inference and projection can be used in conjunction with available data to evaluate a taxon against the criteria. However, when inference or projection is applied, the assumptions must be documented. If there is reasonable concern that a taxon faces imminent extinction, it should be classified under one of the threatened categories.

Criteria Implementation

In our Red Listing of Palestinian vascular flora, Criteria A and E were not applied to any species due to a lack of quantitative data on generation length and population reduction rates. Criterion B was predominantly used, as data was available on the distribution range (collected from BIOGIS, GBIF, herbarium labels, databases, and field surveys) and the number of locations. Criteria C and D were applied to species with very restricted distributions, small population sizes, or a limited number of mature individuals, where data on subpopulations were available.

Components of the Red List Assessment

For each species, three primary components were created: 1. Red List Category Assignment: Each species was assigned a Red List category based on the five IUCN criteria. 2. Supporting Documentation: A comprehensive justification for the assessment was provided, including data on species distribution, population size, trends, habitat descriptions, ecological requirements, local uses, threats, and current or proposed conservation actions. 3. Distribution Map: A

distribution map was generated for each species, illustrating its geographical range. Following is an example of the supporting documentation including the distribution map of *Iris lortetii* var *samaria* assessment (Figure2)

Table 2. Summary of the five criteria (A–E) utilized to assess whether a taxon qualifies for inclusion in a threatened category (Critically Endangered, Endangered, or Vulnerable) on the IUCN Red List.

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation *[except A3]*

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality

(d) actual or potential levels of exploitation

(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) **(i)** Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) **(ii)** % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative Analysis

	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Iris lortetii var. *samariae* (Dinsm.) Feinbrun

Kingdome Plantae, **Phylum** Tracheophyta, **Class** Liliopsida, **Order** Asparagales, **Family** Iridaceae, **Genus** *Iris*, **Species** *lortetii* **variety** *samariae*

Common name: Nablus Iris

Common Arabic name: سوسن نابلس، السوسن الأبيض

Conservation Status-IUCN		
EN B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)		
Extent of Occurrence 182 km^2	**Area of Occupancy** 60 km^2	**Number of locations** 15

Justification: The variety is endemic to state of Palestine, where it is restricted to the Nablus Mountains. Based on available distribution data, the area of occupancy (AOO) is estimated at 60 km2 and is certainly less than 500 km2. The extent of occurrence (EOO) is 182 km^2. The variety is severely fragmented with continuing decline in the number of mature individuals, the number of subpopulations, in AOO, and in the area and quality of habitat. As a result, the plant qualifies as Endangered (EN B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)).

Population: The plant population is severely fragmented divided into subpopulations based on their relative isolation (distance, presence of natural or artificial barrier). The overall population size is estimated to be less than 2,500 mature individuals (847) and the population trend is declining. The plant was recorded in 27 subpopulations all within the Nablus Mountains area. The number of subpopulations has declined by c.44% over the last forty years, and some subpopulations are likely to have been lost.

Geographic Range: The plant is endemic to the Nablus Mountains in the northern West Bank (Palestine).

Life form: Geophytes

Pollination system: Animal pollination

Climatic region: Transition zone

Chorotype: Mediterranean

Habitat: Batha

Ecosystem: Semi-Steppe Batha

Threats: The major threat to the species is the collection of flowers and the collection of tubers due to its extreme attractiveness and its reputation among nature lovers. Additional threats also include road construction, small population size, conversion of natural land to agricultural lands, overgrazing, tourism, and leisure, herbicides and pesticides usage, increased frequency/intensity of fires, garbage and solid waste, residential and commercial development, mining and quarrying, and drought.

Conservation: *Ex-situ* conservation is in place at the national conservation site for royal irises and other endemic endangered plants within the BERC Botanical Gardens (Til, Nablus), and *quasi-in-situ* conservation in micro reserves in five sites in the Nablus area. The West Bank protected areas should be expanded where possible to include habitat for this variety. The plant has been successfully restored in two locations (Qeshda and Til).

General Use and Trade Information: Used as an ornamental plant

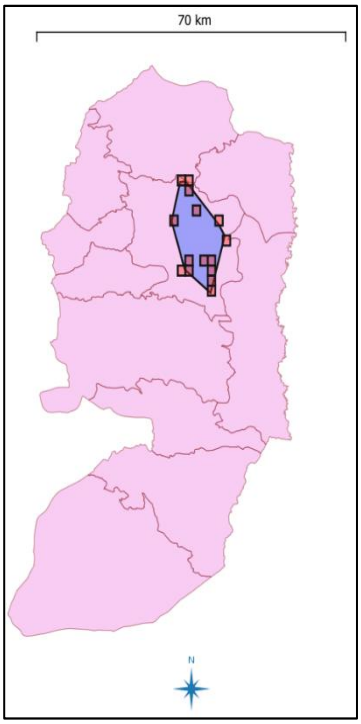

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Figure 2. Example of the supporting documentation, including the distribution map, for the assessment of *Iris lortetii* var. *samariae* assessment

RESULTS AND DISCUSSION

Our assessment of the native vascular plants in the West Bank revealed that 27.69 % (482 out of 1,741 taxa) are classified under threat categories, with 94 taxa (5.40%) listed as Critically Endangered (CR), 170 (9.76%) as Endangered (EN), and 218 (12.52%) as Vulnerable (VU) (Table 3, Figure 3). Additionally, 401 taxa (23.08%) were categorized as Near Threatened (NT), while 710 taxa (40.78%) were assessed as Least Concern (LC) and 121 (6.95%) were Data Deficient (DD) (Table 3).

Notably, 27 species were classified as Extinct (EX) (Table 4), as they are only known from type specimens collected in the previous century (Flora of Israel Online, Feb 2025). These findings underscore the urgent need for conservation efforts, as they represent the most comprehensive Red Data List of native vascular plants for the West Bank to date. This list provides a critical tool for recognizing and conserving threatened flora at both national and global levels.

Table 3. Number and proportion of vascular plant taxa in each Red List category in the Palestinian West Bank.

Category	No. of taxa	% of total
Regionally Extinct (RE)	27	1.55
Critically Endangered (CR)	94	5.40
Endangered (EN)	170	9.76
Vulnerable (VU)	218	12.52
Near Threatened (NT)	401	23.03
Least Concern (LC)	710	40.78
Data Deficient (DD)	121	6.95
Total	**1741**	**100**

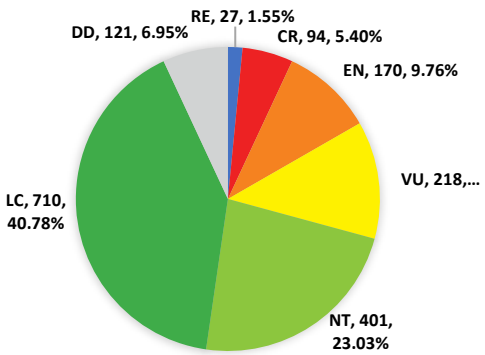

Figure 3. The proportion of vascular plant taxa in each Red List category in the West Bank.

Table 4. Taxa assessed as Regionally Extinct (27).

Aegilops vavilovii	*Lathyrus gloeosperma*
Alisma lanceolatum	*Juncus sphaerocarpus*
Alkanna orientalis	*Leptadenia pyrotechnica*
Avena fatua	*Lotus ornithopodioides*
Bunium ferulaceum	*Medicago murex*
Bupleurum orientale	*Medicago tornata*
Clinopodium barbatum	*Oenanthe prolifera*
Cornucopiae alopecuroides	*Orchis italica*
Crypsis acuminata	*Pseudognaphalium luteoalbum*
Crypsis minuartioides	*Salvia bracteat*
Cyperus jeminicus	*Sambucus nigra*
Euphorbia forsskalii	*Scandix Iberica*
Globularia arabica	*Tephrosia purpurea subsp. Apollinea*
Lamium orientale	

Comparative Analysis with Previous Assessments

A comparison with previous conservation assessments conducted in 2002 and 2018 (Ali-Shtayeh and Jamous, 2002; Ali-Shtayeh et al., 2018) reveals a decline in the conservation status of native taxa over the past two decades. Specifically, more than 20 % of the assessed flora falls into high-risk categories (CR and EN), reflecting increased vulnerability compared to the 2018 assessment.

Unlike previous assessments, the heightened vulnerability observed in this study can be largely attributed to climate change and increasing aridity affecting the West Bank, particularly at lower elevations in the eastern regions. These environmental changes have likely led to population declines and reduced distribution ranges for several taxa. This aligns with global studies linking climate change to increased extinction risks in semi-arid ecosystems (IPCC, 2021; Parmesan & Yohe, 2003).

Methodological Considerations and Limitations

Over the past 22 years, the IUCN Red List system has undergone significant refinement (IUCN, 2022). Consequently, caution is necessary when comparing our findings with previous assessments by Ali-Shtayeh and Jamous (2002) and Ali-Shtayeh et al. (2018) due to differences in methodologies. Although our results indicate an increased extinction risk over the last two decades, several factors may also account for this trend including (a) the utilization of more accurate and comprehensive data, leading to more realistic assessments; (b) the application of advanced IUCN tools, such as the RAMAS software, compared to previous reliance on expert opinion; (c) Expanded threat analyses, including anthropogenic pressures and climate change impacts; and (d) broader assessment coverage encompassing all native vascular flora, with numerous taxa being categorized for the first time.

Threats and Conservation Implications

The high percentage of threatened taxa in the West Bank is concerning. Like other semi-arid ecosystems, habitat degradation, human disturbances (e.g., agricultural expansion), and the introduction of exotic species are major threats (Sala et al., 2000; Thuiller et al., 2005). Species with restricted geographical ranges, both in terms of Area of Occupancy (AOO) and Extent of Occurrence (EOO), are particularly susceptible to extinction.

To mitigate these risks, several conservation actions are recommended: (a) the reorganization of Protected Areas (PAs): Enhancing the representativeness of the PA network to cover at least 30% of each of all the region's ecosystems; (b) the establishment of New PAs and Micro-Reserves: These measures would safeguard the unique natural heritage of the West Bank (Ali-Shtayeh et al., 2022b, 2025); and (c) species prioritization: Given the socio-economic constraints and competing land-use demands, prioritizing species for conservation is crucial for effective resource allocation.

Conservation Strategy and Policy Implications

This Red Data List serves as a vital baseline for conservation prioritization in the Palestinian West Bank. It provides scientifically robust data to guide governmental conservation strategies, aligning with international biodiversity conservation efforts (CBD, 2020; IUCN, 2022).

Despite the resource limitations faced by conservation initiatives, implementing informed, integrative approaches is essential for preserving the region's unique flora. The findings emphasize the need for a strategic conservation framework, enabling the Palestinian government to prioritize actions that ensure the long-term survival of the most threatened plant species.

Constraints of assessing Palestinian West Bank native vascular plants using IUCN criteria

Assessing the conservation status of native vascular plants in the Palestinian West Bank using IUCN Red List criteria presents multiple challenges, many of which are common to small, geographically restricted regions. These constraints stem from factors such as habitat fragmentation, data deficiencies, political and environmental challenges, and the limitations of applying global conservation criteria to a localized context.

Restricted Geographical Distribution and Habitat Fragmentation

The Palestinian West Bank is a relatively small geographic region with highly fragmented habitats due to urban expansion, agricultural activities, and infrastructure development. IUCN Red List criteria, particularly those related to Area of Occupancy (AOO) and Extent of Occurrence (EOO), may classify many species as threatened simply due to their restricted distribution rather than actual extinction risk (IUCN, 2012). This could lead to an overestimation of threat levels, affecting conservation priorities and resource allocation. Additionally, fragmentation limits gene flow between populations, increasing their vulnerability to extinction (Romeiras et al., 2016).

Data Deficiency and Limited Research

A major constraint in applying IUCN criteria is the lack of comprehensive, up-to-date data on species distribution, population trends, and threats. Many native plant species in the West Bank remain understudied, leading to their classification as "Data Deficient" (DD) under the Red List. This classification, while acknowledging the need for further research, can hinder conservation efforts by failing to provide clear guidance on priorities (IUCN, 2012). Similar challenges have been observed in assessments of other small regions, such as the Cape Verde endemic flora, where limited taxonomic research and outdated records complicated the application of Red List criteria (Romeiras et al., 2016).

Threats from Human Activities

Human-induced habitat destruction is a significant threat to native plant species in the West Bank. Urbanization, deforestation, intensive agriculture, and infrastructure projects contribute to habitat loss and degradation. Additionally, overgrazing, pollution, and land-use changes further endanger plant populations. The region's political instability complicates conservation initiatives, as land-use policies often prioritize development over biodiversity protection (IUCN, 2012). In many cases, conservation efforts are fragmented, with limited enforcement of existing environmental regulations.

Climate Change and Environmental Factors

The West Bank is susceptible to climate change effects such as altered rainfall patterns, increased droughts, and desertification, all of which negatively impact native plant species. However, IUCN criteria do not always fully account for climate change's long-term impact, especially on slow-growing or long-lived species that may not show immediate population declines. This limitation can lead to an underestimation of future threats and insufficient conservation measures (Romeiras et al., 2016).

Regional and Political Constraints in Conservation Planning

The application of IUCN Red List criteria in politically occupied areas like the West Bank presents additional challenges. Conservation policies, funding availability, and research collaboration across borders can be severely limited. Differences in legal frameworks, governance structures, and land management strategies between Israeli and Palestinian authorities create obstacles to implementing a unified conservation strategy. As a result, conservation efforts may lack coordination, making it difficult to develop comprehensive regional plans for protecting native plant species (IUCN, 2012).

Need for Alternative Conservation Strategies

Given these constraints, alternative conservation strategies are essential for ensuring the survival of native vascular plants in the Palestinian West Bank. Traditional IUCN Red List assessments primarily focus on global extinction risk, yet in small, fragmented landscapes, localized conservation efforts tailored to the region's specific challenges may be more effective. A multifaceted approach integrating in-situ and ex-situ conservation, habitat restoration, and community engagement can provide a more sustainable solution for preserving plant biodiversity.

In-situ Conservation

Protecting plant species within their natural habitats is a fundamental strategy. This can be achieved through the establishment of protected areas, conservation reserves, and ecological restoration initiatives. Given the political complexities of the region, community-managed conservation areas, where local populations take an active role in habitat protection, can be particularly effective. Such initiatives can blend traditional ecological knowledge with scientific research to develop sustainable conservation practices that align with local socio-economic conditions (IUCN, 2012).

Ex-situ Conservation

Complementing in-situ efforts, ex-situ conservation is crucial in safeguarding species that face immediate threats from habitat destruction, climate change, or land-use conflicts. Botanical gardens, seed banks, and tissue culture techniques are vital repositories for preserving genetic diversity. Institutions within the region, alongside international partnerships, can contribute to long-term conservation by facilitating research, breeding programs, and future reintroduction initiatives to restore native plant populations (Romeiras et al., 2016).

Quasi-in-situ Conservation

Quasi-in-situ conservation is a conservation strategy that combines elements of in-situ (on-site, in the natural habitat) and ex-situ (off-site, outside the natural habitat) conservation. It involves the translocation of species or populations from their original locations to new but ecologically similar

habitats, typically within the species' historical or potential range.

Habitat Restoration and Ecological Rehabilitation

Reversing the impacts of land degradation, deforestation, and urban expansion is critical for conservation success. Targeted reforestation projects, soil conservation measures, and the reintroduction of native species into degraded landscapes can help restore ecological balance. Additionally, creating habitat corridors to connect isolated plant populations can enhance genetic diversity and resilience, mitigating the risks associated with fragmentation and environmental changes (Romeiras et al., 2016).

Community Engagement and Education

Community involvement is a key factor in ensuring long-term conservation success. Raising awareness among local communities, farmers, and policymakers about the ecological and cultural significance of native plants fosters a more conservative-conscious society. Encouraging biodiversity-friendly agricultural practices, sustainable urban planning, and ecotourism can support economic growth while promoting environmental stewardship. Integrating conservation principles into school curricula and public outreach programs can further strengthen community participation in protecting native flora (IUCN, 2012; IUCN, 2024a).

CONCLUSIONS

This assessment represents a foundational step toward a more effective conservation strategy for native vascular plants at risk in the West Bank. By leveraging comprehensive data and advanced assessment methodologies, this study enhances our understanding of the region's threatened flora and informs targeted conservation actions crucial for biodiversity preservation. However, while IUCN Red List assessments provide valuable insights into species' conservation status, they must be supplemented with region-specific strategies that address local ecological and socio-political realities. The unique challenges of the Palestinian West Bank, such as habitat fragmentation, data deficiencies, political instability, and climate change, necessitate adaptive conservation approaches beyond Red List categorizations. A combination of *in-situ*, *quasi-in-situ*, and *ex-situ* conservation, habitat restoration, and active community involvement can create a more effective and sustainable conservation framework. By implementing these alternative approaches, the Palestinian West Bank can enhance the protection of its native vascular plants and contribute to broader regional and global biodiversity conservation efforts.

FORMAT OF THE RED LIST

Descriptions of Red List columns

Taxon Name: The name and taxonomic concept of listed taxa follows The World Flora Online (https://www.worldfloraonline.org/), wherein authorities for taxon names are to be found in IAPT (https://www.iaptglobal.org/) and IPNI (2016), and elsewhere.

PAL RL Category: Palestinian West Bank Red List Category, resulting from assessments undertaken. Category abbreviations: RE = Regionally Extinct, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern. Taxa assessed as CR, EN and VU are considered as threatened and Red-listed.

Criteria: IUCN criteria and subcriteria giving rise to Palestine Red List Category. Descriptions and thresholds for these are provided in Tables 4 and 5.

PAL End: Palestinian West Bank Endemic. A taxon is defined as endemic if its entire native distribution is confined to the Palestinian West Bank and surrounding areas.

Glob RL: Red List status of taxa globally (G) as given in the IUCN Red List of Threatened Species (IUCN, 2024b).

Jo RL: Red List status of taxa in Jordan as given in Taifour and El-Oqlah (2014) and Taifour (2017). Category abbreviations are as defined elsewhere in this Red List.

HPAL RL: Red List status of taxa in Historic Palestine as given in PARKS (https://redlist.parks.org.il/en/plants/list/). Category abbreviations are as defined elsewhere in this Red List.

Evaluated Taxa

Only taxa native to Palestine were considered for evaluation in this study. The following pages constitute a list of all the species evaluated using the most recent version of the IUCN Regional Categories and Criteria (IUCN, 2001). In addition to the IUCN Red List status determined for each species, specific data is provided for each plant (including comments/justification and Bibliography), along with its geographic range and reference