UPDATING AND ENHANCING THE PROTECTED AREAS NETWORK OF PALESTINE: A STEP TOWARDS BIODIVERSITY CONSERVATION

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ABSTRACT

The Protected Area Network (PAN) in Palestine has undergone a comprehensive evaluation and revision to ensure its effectiveness in conserving biodiversity. This re-evaluation was necessary as the previous PAN lacked clear rationale and included areas designated for non-biological reasons. The evaluation process involved analysing the 50 areas in the previous PAN, as well as conducting Marxan analysis and incorporating new data based on IUCN criteria. The evaluation process led to eliminating, combining and adjusting areas, resulting in a revised PAN consisting of 28 areas. This updated PAN represents all vegetation types and phytogeographical zones in Palestine, effectively protecting key ecoregions in the Mediterranean hotspot. The revision of the PAN has increased the total protected land mass from 9 per cent to 9.98 per cent. This expansion provides additional areas where biodiversity can thrive undisturbed, ensuring the long-term survival of species and ecosystems. The updated PAN was adopted at the highest level of government, signifying the importance and commitment to biodiversity conservation in Palestine. This achievement demonstrates the progress made by Palestine in safeguarding its natural heritage.

Key words: protected area designation, Marxan analysis, bridging science–policy–practice gaps.

INTRODUCTION

Substantial advances have been made related to Aichi Target 11, with the protected areas (PAs) estate increasing globally by 2.3 per cent on land and 5.4 per cent in the oceans between 2010 and 2018, and now covering 15 per cent of land and inland freshwater globally and 7 per cent of the oceans (UNEP-WCMC & IUCN, 2020). Yet, both within and outside PAs, biodiversity globally continues to decline. For example, over one-third of PAs have suffered increasing human pressure (Jones et al., 2018). Further, only half of the protected areas globally show connectivity (Saura et al., 2018; Ward et al., 2020). The Kunming-Montreal Global Biodiversity Framework (GBF) proposed in Target 3 that "by 2030 at least 30 per cent of terrestrial and inland water areas, and of marine and coastal areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognising indigenous and traditional territories, where applicable, and integrated into wider landscapes, seascapes and the ocean, while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognising and respecting the rights of indigenous peoples and local communities, including over their traditional territories" (CBD, 2022). This was incorporated into the new National Biodiversity Strategy and Action Plans for Palestine (EQA, 2023).

The network of Palestinian protected areas was developed through a complex history from the 1990s when several areas were turned over to the nascent Palestinian authority. The designated 51 areas were then reduced to 50 (49 in West Bank and 1 in Gaza). Yet, due to limited capacity and political issues, there was never a real (re)evaluation of these areas or attempts at studying other potential areas worthy of conservation. As noted in the sixth national report, protected areas in Palestine and

Wadi Al-Qilt with an oasis like habitats © Palestine Institute for Biodiversity and Sustainability

areas of significant importance to them (like the Jordan Valley) are not representative of ecozones/habitats or of actual needs, as this study shows, and are not protected in practice (EQA, 2021). This problem is not only local but global: expansion of protected areas by national governments since 2010 has "had limited success in increasing the coverage across different elements of biodiversity" (Maxwell et al., 2020). An important first step in addressing this issue is to allow local communities to have control over their land and natural resources For more on this subject see Qumsiyeh and Amr (2016) and Qumsiyeh and Albardeiya (2022).

A review and update of the protected area network (PAN) for Palestine was conducted during 2021–2022 using systematic conservation planning principles, CBD protected area design criteria, and IUCN categorisation to establish a representative, efficient and climate-resilient network.

METHODS

Study area

The study area is the Palestinian Territory (hereafter Palestine) , located between the Eastern Mediterranean and west of the Jordanian River, includes 5,860 km². While we could not travel to Gaza Strip for field work, we included the protected area of Wadi Gaza and included in analysis based on available data on that area. The study included 50 'nature reserves/protected areas' listed by Israel in the area (Figure 1) in addition to eight other areas (seven identified by initial Marxan analysis and one by data collected and not included in Marxan).

Marxan analysis and GIS modelling

ArcGIS software was used to prepare the input layers and present modelling output, and Marxan Systematic Conservation Planning Software was used to perform

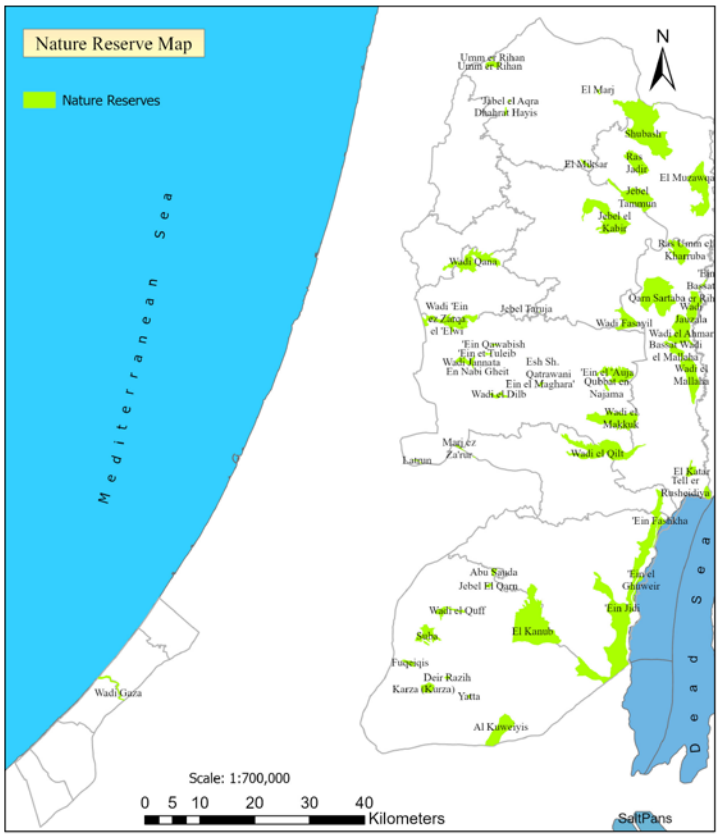

Figure 1. The study area presenting the previous PAN areas designated by Israeli occupation authorities. (Environment Quality Authority)

the conservation planning analysis (Ball & Possingham, 2000; Possingham et al., 2001), by comparing alternate solutions composed of a set of planning units using a mathematical function that assigns a value for each set of units. The value is assigned based on the cost of including the planning units in the PA network and the cost of not meeting conservation targets. Giving a value for each set of planning units, or options (solutions), for reserve networks will enable the automation of the selection of good PA networks. Marxan also allows a consideration of the fragmentation of the PA network by testing the boundary length of each alternative for the PA network. Marxan addresses these requirements by having defined targets for each identified conservation feature. These targets become design constraints and are tested against the cost of the design.

To apply Marxan analysis in this study, the following steps were taken:

1. **Preparation of planning units:** The official border map for Palestine was obtained from the Palestinian Environment Quality Authority (EQA). The area was divided into identical hexagon planning units, each with a size of 100 ha. The planning units were created using the extension 'Repeat shapes for ArcGIS 10.8' from Jenness Enterprises http://www.jennes-

Table 1. Layers used to create the Relative Biodiversity Index (RBI)

Risk element	Geometry type	Intensity value	Influence distance (m)	Distance decay
Built up areas	Polygons	100	5000	Concave
Municipal organisational boundaries (Master plan)	Polygons	100	5000	Concave
Major roads	Lines	100	5000	Convex
Minor roads	Lines	100	5000	Convex
Negative land use types	Polygons	100	5000	Concave
Construction sites	Points	100	5000	Concave

Table 2. Layers used to create the RBI: NT (not threatened), VU (vulnerable), EN (endangered), CR (critically endangered)

Layer name	Geometry type	Source
Distribution of threatened plants NT, VU, EN, CR	Points	https://www.gbif.org/ Banan Al Sheikh
Distribution of threatened fauna and avifauna NT, VU, EN, CR	Points	https://www.gbif.org/
IBAs	Polygon	BirdLife International (2017)
KBAs	Polygon	KBA Database https://www.key-biodiversityareas.org/
Existing PAs	Polygon	EQA

sent.com. The total number of resulting planning units was 5,913 planning units, which were used as the basis of analysis and for assessing environmental risk, conservation value and identifying the PA design scenarios.

2. **Identifying the environmental risk surface (ERS):** ERS for this project was created using the 'Protected Area Tools for ArcGIS' plug-in developed by the Nature Conservancy in 2008 (Schill & Raber, 2009). In order to produce a modelled risk surface, each risk element should be mapped individually, then all risk elements should be combined. A risk element could be represented by a point, line or polygon. Each risk element is then assigned values (intensity value, influence value, distance decay function) (Table 1).
3. **Relative biodiversity rareness index (RBI):** used as complementary to the Marxan analysis. The RBI analysis is used to calculate the relative uniqueness or rareness of habitats across a study area and quantify the area weighted relative contribution of each planning unit compared to the total distribution of each conservation target using the following equation as stated in Schill and Raber (2009) (see Table 2). Existing Important Bird Areas (IBAs) and Key Biodiversity Areas (KBAs) were included even though we think both need to be reevaluated based on more detailed scientific data yet to be collected. We also took into account proposed important plant areas (Radford et al., 2010).
4. **Preparation and running of Marxan:** input files from previous steps were prepared and uploaded to the software, and four different scenarios were applied to produce a proposal for the new PAN in Palestine. The four scenarios considered the conservation percentage of vegetation types (VT) and extent of occurrence (EOT) of threatened animals and plants, specifically: 1) VT 5%, EOT 5%; 2) VT 10%, EOT 10%; 3) VT 17%, EOT 20%; 4) VT 30%, EOT 20%. The four scenarios were then compared to find the areas of overlap and consolidate them into the most critical areas identified by Marxan analysis (see results).
5. **Additional data gathering and validation:** Per standard protocols (e.g. Daigle et al., 2020), key data were gathered on each area including species distribution and threats collected from fieldwork, internet available data, publications, published research papers, https://www.gbif.org/ and https://biogis.huji.ac.il/ data. Data was collected on elements needed for scoring based on the criteria. Information on suggested management of areas, including threats and opportunities, was added when not available. Buffer zones were considered, but were not necessarily added to the protected area itself, creating

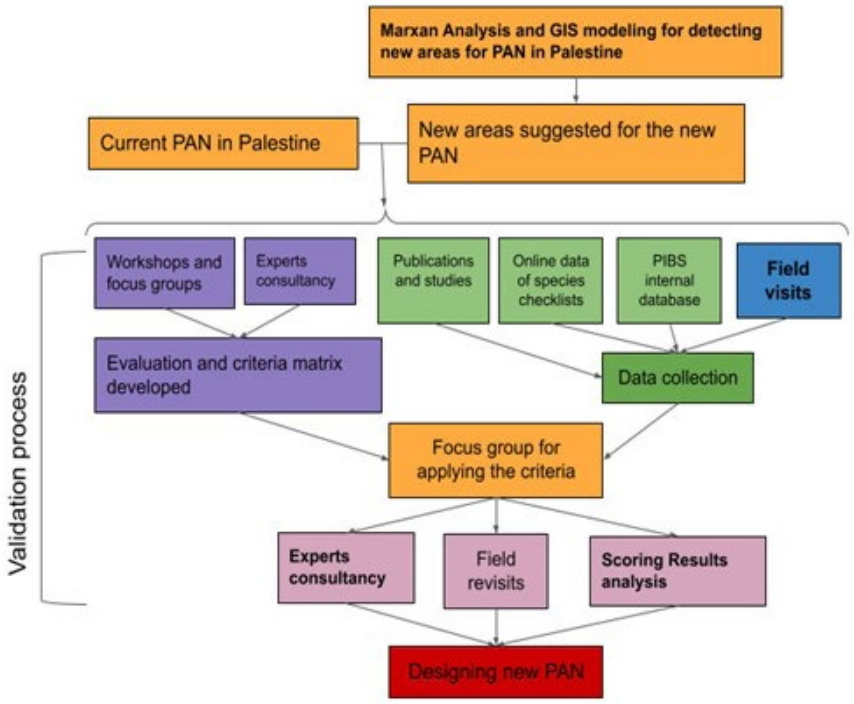

Figure 2. Methodological framework

an internal database of data for each PA. Between March 2022 and August 2022, 22 field trips were conducted by biodiversity experts from the Palestine Institute for Biodiversity and Sustainability (PIBS) and EQA, to provide an updated status of the PAs based on the criteria. Notes were taken, including on urban expansion and settlements near PAs. All protected areas were visited except Um Rihan which was annexed to the Israeli territories and inaccessible to Palestinians.

6. **Criteria development and application:** Considering IUCN guidelines and the above studies, 13 principles were adopted for the PA validation, and criteria and measures were developed with numeric values for scoring and validation of each area based on the principles and criteria listed here https://www.palestinenature.org/conservation/f3e7553fb6.pdf. The highest possible score was 53 and lowest score 15 (median 34). Scoring was done collectively by consensus and involved representatives of EQA and PIBS as well as external experts. When information was lacking in any particular category, it was scored as average to avoid biasing data. The methodological framework is summarised in Figure 2.

RESULTS

Each of the four Marxan scenarios resulted in a proposal to include planning units within the PAN that achieve the conservation targets set for each scenario. The ensemble of the four scenarios was considered the basis for the collective PAN review proposal. Overlay analysis of the solutions of each of the four Marxan scenarios

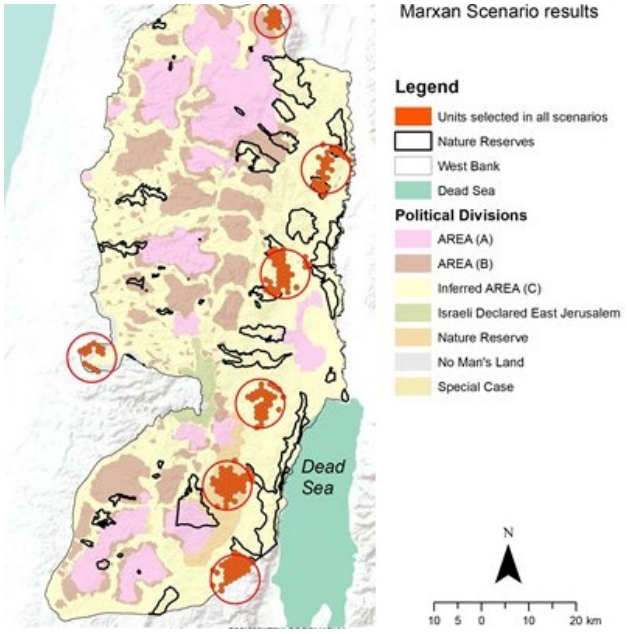

Figure 3. The Marxan scenario for protected areas in Palestine identified seven key areas and one was added later for further analysis (Environment Quality Authority)

highlighted seven areas that were common and were thus proposed for inclusion in the PAN revaluation (Figure 3). The Marxan analysis was done before data became available from an eighth area called Al-Arqoub (south Jerusalem Hills) which showed important biodiversity (see Qumsiyeh et al., 2023), so this area was also added for further evaluation.

Table 3. List of protected areas in the new PAN. The IUCN categories from I to VI are designated based on Dudley (2008) plus the intensive focus group and workshop meetings

Protected areas	Area (km^2)	Governorate/s	IUCN category	Other notes
Dead Sea	235.08	Jericho, Jerusalem, Bethlehem, Hebron	IV	The most important area with potential for designation under IUCN as Red Listed ecosystem
Ein el Auja	12.37	Ramallah and Al Bireh	II	Unchanged borders
Jerusalem Wilderness area	52.84	Jerusalem, Bethlehem, Jericho	Ib	Newly designated PA
Wadi el Qilt	28.64	Jericho, Jerusalem, Ramallah and Al Bireh	IV	Very small adjustments in borders on the western side
AlAghwar (Jordan Valley)	54.52	Jericho	II	Combining four previously adjacent areas
Wadi Fasayil	8.38	Jericho, Nablus	II	Unchanged borders
Al Kanub	29.02	Hebron	IV	Significant adjustments of borders
Al Muzawqa	28.33	Tubas	IV	Border adjustments
El Miksar	1.22	Jenin	IV	Border adjustments
Latrun	2.33	Ramallah and Al Bireh	IV	Newly designated PA
Marj ez Zarur	2.30	Jerusalem	IV	Unchanged borders
Qarn Sartaba	31.19	Jericho	IV	Border adjustments
Umm er Rihan	3.70	Jenin	IV	Border adjustments
Wadi Ein ez Zarqa el Elwi	10.53	Ramallah and Al Bireh, Salfit	IV	Border adjustments
Wadi Jannata	2.80	Ramallah and Al Bireh	II	Border adjustments
Wadi Qana	15.30	Salfit, Qalqilya	II	Border adjustments
Al Kuweiyis	12.69	Hebron	IV	Border adjustments
Ain Qawabish	0.452	Ramallah and Al Bireh	V	Border adjustments
Deir Razih	0.352	Hebron	V	Border adjustments
El Katar	3.18	Jericho	V	Unchanged borders
El Marj	0.41	Jenin	V	Significant adjustments of borders
Jabal Al-Qarn	0.533	Hebron	V	Potential national eco-garden
Ras Jadir	9.50	Tubas	IV	Significant adjustments of borders
Shubash	52.86	Tubas, Jenin	V	Potential biosphere reserve
Al Arqoub	9.10	Bethlehem	V	Potential biosphere reserve
Wadi Al Quff	3.44	Hebron	V	Potential biosphere reserve
Wadi ed Dilb	1.56	Ramallah and Al Bireh	VI	Significant adjustments of borders
Wadi Gaza	2.84	Gaza	VI	Unchanged borders

Thus, as a basis for **field validation** and for finalising the revised PAN, the following areas were validated:

- Areas that were selected in each Marxan scenario (Figure 3);
- Existing PAs that were not selected in any of the PA scenarios (except scenario 4 as it has current PAs locked in the model);
- PAs that are adjacent to each other with no clear reason for separation. This was to validate if there are practical reasons or field observations to support the decision to keep adjacent PAs separate;
- PAs that are small in size (less than 1 km^2), this was to validate these sites against the PAN design criteria and provide recommendations regarding their status.

A set of criteria was developed and assigned weights for evaluation of all 50 previously listed protected areas plus eight potential new areas (seven identified from Marxan and one from new data). Because of the tabulations of the scores, the maximum score was 48/53 and the minimum was 21/53. Raw data and scoring can be found as supplementary material (https://www.palestinenature.org/conservation/f3e7553fb6.pdf).

Table 4. Vegetation cover in the new PAN

Vegetation cover	Area of vegetation cover (km²)	Designated PAs (area within vegetation type km²)	% of vegetation type from designated PAs	KBAs (area within vegetation type) km²	% of vegetation type from KBAs
Desert savanna vegetation (15)	227	74.30	32.7	130	57.2
Desert vegetation (12)	187	97.38	52.1	81	43.3
Maquis and forest (1)	2,559	53.86	2.1	531	20.7
Oases with Sudanian trees (14)	87	9.39	10.8	28	32.1
Park forest of *Ceratonia siliqua and Pistacia lentiscus* (5)	917	59.03	6.4	185	20.1
Mediterranean Savannoid vegetation (7)	74	0.64	0.9	11	14.8
Semi-steppe batha (8)	846	123.40	14.6	333	39.3
Steppe vegetation (10)	448	153.64	34.3	167	37.2
Swamps and reed thickets (17)	5	2.51	50.2	3	60.0
Synanthropic vegetation with *Ziziphus spina-christi trees* (19b)	65	0.00	0.0	3	4.62
Synanthropic vegetation with *Ziziphus spina-christi* and *Acacia raddiana* trees (19c)	3	0.00	0.0	0	0.00
Wet salines (18)	101	21.99	21.8	60	59.4
***Ziziphus lotus* with herbaceous vegetation (6)**	135	17.73	13.1	42	31.1
Total	5,427	614	-	1,574	-

The assessment team set a cut-off value of 30 and all areas receiving a score of 30 or below were excluded, 19 of the original PAs and three of the Marxan identified areas (total 22 areas) scored 30 or less (Table 3) via the identified criteria and were eliminated from further consideration. Examples of these are very small areas like an area of less than 6,000 m² called Ash Sheikh Qatrawwani near Attara whose trees are mostly planted and around a shrine which is protected already as a town's recreational area. Many others were designated by Israel as 'nature reserves' without sufficient biological justification: Wadi Al Makkuk is used as a military training ground and Ein Al Maghara and Qubbat en Najama were already used for expanding nearby Jewish settlements (Beit El and Rimonim respectively). The remaining 36 areas that scored high based on the criteria were revisited for potential mergers, and border adjustments were made using ArcGIS software based on on-the-ground evaluations, proximity and current maps. This resulted in a final list of 28 proposed PAs covering 9.98 per cent of the landmass of Palestine (Table 3). These PAs cover all ecosystems, habitats and phytogeographical regions and aim to represent at least 10 per cent of all vegetation cover types. The original network is shown in Figure 1 and the new PAN is shown in Figure 4. In addition, the vegetation cover size is calculated within the new PAN, as shown in Table 4.

Categorisation of the new network

In collaboration with stakeholders, we looked at the new PAN and gave them designations per IUCN criteria (Dudley, 2008) (Table 3). Determining whether a site is or should be a protected area as defined by IUCN is far more difficult than giving it a categorisation. See discussion for issues of implementation.

The 28 areas identified in the new PAN for Palestine cover all vegetation classifications (Table 4), all phytogeographical zones, key habitats, and the two ecoregions identified as part of the critical biodiversity hotspots in the Eastern Mediterranean region (the Conifer-Sclerophyllous broadleaf forests and the Jordan River basin habitats, Birdlife International, 2017). If

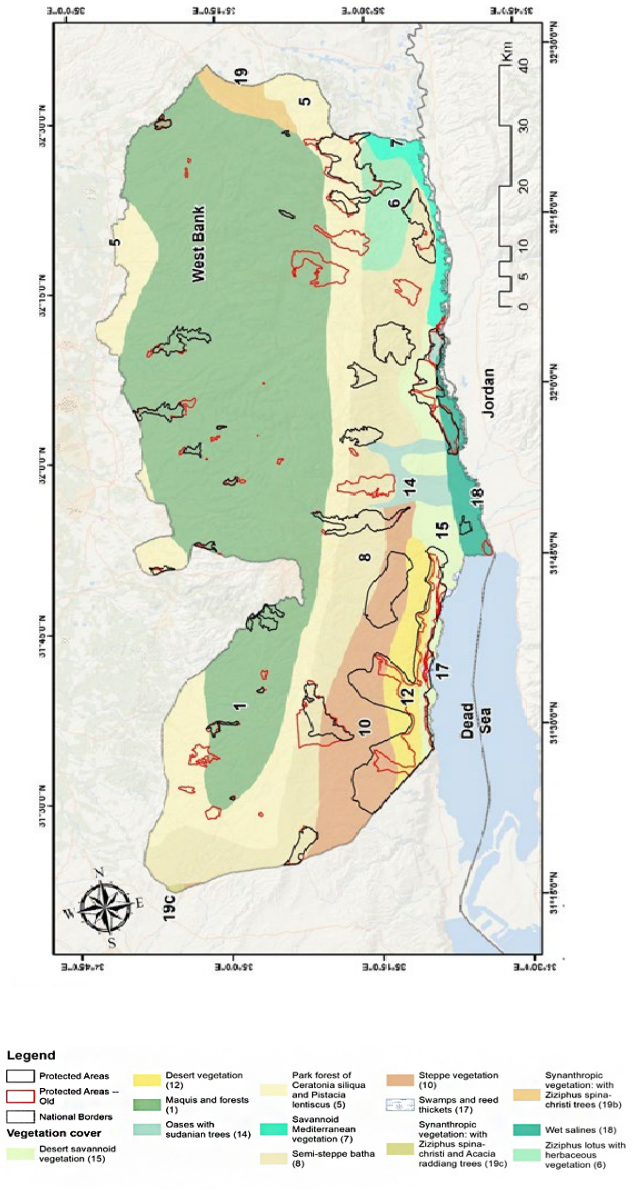

Figure 4. View of the new proposed network in relation to habitats. Here and elsewhere, red shows old borders or areas, and black shows new ones (Environment Quality Authority)

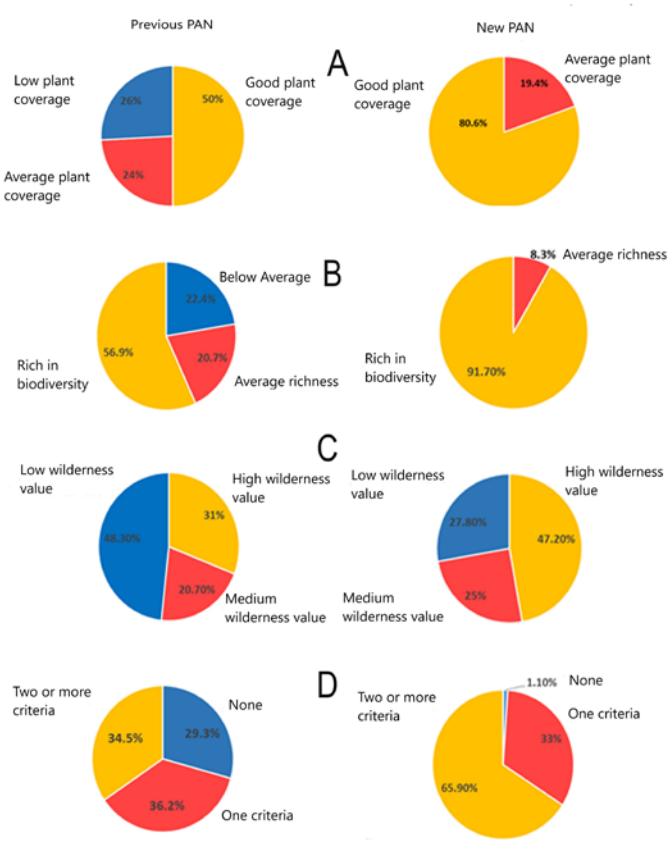

Figure 5. Selected categories for representation in the old PAN and the new PAN: (a) plant cover (b) richness in biodiversity (c) wilderness/wildness value (d) existing designation as KBA, IBA, IPA, etc. (e) land ownership

managed well, the PAN can protect the majority of known endangered and threatened species in Palestine. The PAN terrain includes:

1. Western slopes (typical Mediterranean) include coastal elements near Qalqilya like Wadi Ein Al Zarqa Al Ulwi PA). Protected areas here are relatively small by necessity as they are located close to urban developments and settlement expansions.
2. Eastern slopes: These are unique habitats with transitions from Mediterranean to Irano-Turanian to Saharo-Arabian elements.
3. Jordan Valley area: This is a semi-arid area with an oasis and penetration of Sudanese-Ethiopian elements.
4. Coastal (Wadi Gaza): With the potential to also include marine protected areas at a later date.

Figure 5 shows improvement in several areas of the new PAN over the earlier PAN.

DISCUSSION AND CONCLUSION

Earlier data are available from several sources, including BirdLife International for the important bird areas, Radford et al. (2011) for the important plant areas, Ghattas et al. (2005) for the natural forests, and Garstecki et al. (2010) for the protected areas. There was a preliminary summary (but not evaluation) of existing protected areas by Qumsiyeh and Amr (2016 also published by HSF, 2017). While significant environmental work was done earlier by the Environment Quality Authority (EQA) and stakeholders to protect the nature reserves, this remained limited because of lack of information and access. Israel controls Gaza's maritime zone and maintains a total blockade of the Gaza Strip. In the West Bank, land designated 'Area C' (the majority of land in the West Bank) is under

Al-Arqoub protected area newly designated (near Battir) © Palestine Institute for Biodiversity and Sustainability

Israeli civil and military control. This limits Palestine's ability to implement spatial planning. Most of the current reserves are located within Area C and under the control of the Israeli civil administration (Garstecki et al., 2010; Görlach et al., 2011; Qumsiyeh & Albardeiya, 2022). It is also worth noting that 36.2 per cent of the designated protected areas overlap with Israeli settlements and 39.5 per cent overlap with closed military areas and bases. Such utilisation of a protected area confirms that their declaration does not correspond to the international definition of a protected area (Dromi & Shani, 2020; Rotem & Weil, 2014). This was seen more clearly in our analysis, with details and data on each PA regarding the reasons for its earlier designation, and as our criteria have shown on some 50 per cent of studied areas with data available, the majority of earlier (Israeli) designated PAs are designated for political purposes (Alterman, 2001). Indeed our analysis shown in the results section led to eliminating many areas and consolidating and restructuring others. The new list of 28 areas increased habitat and species representation and was initially adopted by the EQA, Ministry of Agriculture, and Ministry of Local Government and then by all ministries at an official cabinet meeting. It was uploaded on https://www.protectedplanet.net/country/PSE. This is done in line with national and global targets and strategies.

Achieving the Global Biodiversity Framework (GBF) requires urgent and intensive actions and PANs are a key component of this (CBD, 2022; Leadley et al., 2020). The 28 areas that were designated as a result of this work represent those with high scores based on the criteria identified and those areas ended up being representative of vegetation types and phytogeographical zones. They range in size from 0.352 to 235.08 km^2. While some small areas were excluded, some were kept because they added value and richness to the PAN (Riva & Fahrig, 2022). The largest designated area combined and expanded a previous one and is now called the Dead Sea PA (category Ia). This work represents the state-of-the-art knowledge regarding PAN. Much more work is needed especially to complete detailed studies of the areas that were not surveyed (for fauna and flora) and to develop management plans for each PA (currently management plans are available for 6 of the 28 areas). The baseline data generated also opens avenues of research in other areas like representation and effectiveness (see examples in Pliscoff & Fuentes-Castillo, 2011; Pressey et al., 2021). Finally, it is recommended that a protected area management agency be established at the central government level, supported by good data underlying policy, which will eventually facilitate an integrated management system for the PAN. It is also suggested that local management be delegated to local entities under the supervision of this authority. The science of area conservation continues to evolve to meet the GBF targets and goals (CBD, 2022; Nicholson et al., 2021). It is recommended that scientific knowledge and flexibility be maintained in Palestine to enable the protection of the few remaining habitats and ecosystems in the country. This can be achieved through transparency, science-based decision-making, democratic participation and local involvement.

A number of gaps and challenges are revealed in the analysis and generation of the new PAN, including a

lack of systematic documentation, weak stakeholder engagement in the planning and designation process, unclear governance and management of protected areas, and unsystematic planning and designation based on natural values. It is evident that there is a need to set clear targets for the conservation of critical habitats and species within the network. Furthermore, current research programmes are not covering protected areas in a systematic manner. There is a need to update and strengthen the current conservation legislation in Palestine in order to comply with international treaties and obligations. To do this, detailed guidance must be provided on how the EQA should fulfil its duties as outlined in Article 40 of the law. Additionally, scientific data must be collected on all protected areas and potential protected areas using the best available methods for geography, geology, hydrology, fauna and flora. This data can then be used to identify biodiversity hotspots for conservation priorities. Furthermore, management plans should be developed that take into account social, cultural and economic factors as well as an ecosystem approach. By doing so, Palestine can ensure that its conservation efforts are effective and in line with international standards. In order to ensure the proper planning and designation of protected areas in Palestine, a clear reference vegetation map must be used. The current review process for protected areas has identified reference vegetation that can be used as a basis for reviewing and updating the PAs network. This reference vegetation map should provide detailed information on the various vegetation types present in Palestine, including their distribution, composition and structure. This will enable decision-makers to make informed decisions about prioritising protected areas.

The fragmented nature of the landscape in Palestine poses a challenge. Tabarelli and Gascon (2005) recommend dealing with such issues by: 1) incorporating protection measures as part of development projects; 2) protecting large areas and preventing the fragmentation of currently contiguous patches of forest; 3) managing forest edges when creating forest patches; 4) protecting gallery forests along waterways to connect isolated forest patches; 5) controlling the use of fire and the introduction of exotic plant species, and limiting the use of toxic chemicals in areas near forest patches; and 6) promoting reforestation and forest cover in critical areas of the landscape.

Another major challenge for the PAN in Palestine is the lack of baseline studies that cover rich biodiversity areas, their location, distribution and what they contain. Some of this work was already done focused on threats (Alhirsh et. Al. 2016; Al-Sheikh & Qumsiyeh, 2022; Qumsiyeh & Abusarhan, 2021; Qumsiyeh et al., 2016) and even

Habitat in Wadi Qana Protected area © Palestine Institute for Biodiversity and Sustainability

a new designation of a threatened "microreserve" was recently done (Qumsiyeh et al., 2022). Yet, significant data must be collected inside and outside the PAN (Cox & Underwood, 2011; Levin & Shmida, 2007). Finally, while we are satisfied that the results of the new PAN are representative, the onus is on the responsible authorities to ensure local participation to conserve these areas and other areas (Beltrán, 2000; Borrini-Feyerabend et al., 2013; Chape et al., 2008) and perhaps even designate some areas as biosphere reserves to ensure adequate valorisation of ecosystem services (Bridgewater, 2016; Ferreira et al., 2018) and integration into the landscape design (Ervin et al., 2010). As the new PAN was adopted by the highest national government authorities (Ministerial Cabinet), it is obligatory on all ministers to implement the relevant portions in their ministries' sectoral plans. Further, the new PAN was incorporated in the new National Spatial Plan which impacts local and national planning, especially land use, thus bridging the science–policy gap. There remains of course a need to bridge the policy–practice gap. To this end, the National Biodiversity Strategy and Action Plan 2023–2050 articulated specific actions to be achieved. This is all contingent on the Israeli occupation allowing such actions especially in parts of the West Bank (60 per cent of the land called 'area C').

An example of this issue is that the management plan for one of the newly designated protected areas was produced ('Al-Arqoub' in South Jerusalem Hills and Valleys) and the local communities with stakeholders engaged in actual activities on the ground to protect it (Qumsiyeh et al., 2023; Qumsiyeh et al., submitted). However, a large part of the natural area was designated for the expansion of existing Jewish colonial settlements. Better protection can be afforded if the local people are not excluded from planning by the authorities, or better yet if the local people are given control of their natural resources as enshrined in UN resolutions and international law. It would also be worthwhile to study many species for potential Red Listing, which aids conservation, and study the areas identified here for potential inclusion on the IUCN Red List of Ecosystems (Hockings et al., 2019; Keith et al., 2015). Especially interesting areas are the areas around the Dead Sea (the lowest point on Earth, part of the Great Rift Valley).

Finally, we note that the methodology for the new PAN articulated here and its inclusion in workshops and focus groups in ways that bridge science–policy–practice gaps will be applicable to many developing countries, especially those facing difficult geopolitical situations. The main point to remember is that local people can and should implement protection despite the challenges they face.

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REFERENCES

Al-Sheikh B. & Qumsiyeh M. B. (2022). Imperiled ecosystems in Palestine: Rare plants as Indicators. In: DiPaolo, D. & Villella, J., *Imperiled: The Encyclopedia of Conservation, Reference Module in Earth Systems and Environmental Sciences*. Elsevier.

Alhirsh, I., Battisti, C. & Schirone, B. (2016). Threat analysis for a network of sites in West Bank (Palestine): An expert-based evaluation supported by grey literature and local knowledge. *Journal for Nature Conservation*, 31, 61–70. https://doi.org/10.1016/j.jnc.2016.03.005

Alterman, R. (2001). National-level planning in Israel: Walking the tightrope between centralization and privatization. In: *National-level planning in democratic countries: An international comparison of city and regional policy-making* (Pp. 257–288). Liverpool University Press.

Ball, I. R. & Possingham, H. P. (2000). *MARXAN (V1. 8.2). Marine reserve design using spatially explicit annealing, a manual*.

Beltrán, J. (Ed.) (2000). *Indigenous and traditional peoples and protected areas: Principles, guidelines and case studies. No. 4.* Gland, Switzerland and Cambridge, UK: IUCN and WWF International.

Birdlife International (2017). *Ecosystem profile: Mediterranean basin biodiversity hotspot*. Critical Ecosystem Partnership Fund.

Borrini-Feyerabend, G., Dudley, N., Jaeger, T., Lassen, B., Neema, P., Phillips, A. & Sandwith, T. (2013). *Governance of protected areas: from understanding to action. Best Practice Protected Area Guidelines Series*. 20.

Bridgewater, P. (2016). The Man and Biosphere programme of UNESCO: rambunctious child of the sixties, but was the promise fulfilled? *Current Opinion in Environmental Sustainability*, 19, 1–6. https://doi.org/10.1016/j.cosust.2015.08.009

CBD (Convention on Biological Diversity) (2022). Decision adopted by the Conference of the Parties to the Convention on Biological Diversity 15/4. Kunming-Montreal Global Biodiversity Framework https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf

Chape, S., Spalding. M. & Jenkins, M. (2008). *The world's protected areas: Status, values, and prospects in the twenty-first century.* Berkeley: University Of California Press.

Cox, R. L. & Underwood, E. C. (2011). The importance of conserving biodiversity outside of protected areas in Mediterranean ecosystems. *PloS One*, 6(1), e14508. https://doi.org/10.1371/journal.pone.0014508

Daigle, R. M., Metaxas, A., Balbar, A. C., McGowan, J., Treml, E. A., Kuempel, C. D., Possingham, H. P. & Beger, M. (2020). Operationalizing ecological connectivity in spatial conservation planning with Marxan Connect. *Methods in Ecology and Evolution*, 11(4), 570–579. https://doi.org/10.1111/2041-210X.13349

Dromi, S. M. & Shani, L. (2020). Love of land: Nature protection, nationalism, and the struggle over the establishment of new communities in Israel. *Rural Sociology*, 85(1), 111–136. https://doi.org/10.1111/ruso.12274

Dudley, N. (Ed.). (2008). *Guidelines for applying protected area management categories*. IUCN. https://portals.iucn.org/library/sites/library/files/documents/pag-021.pdf

EQA (Environment Quality Authority) (2021). *6th National Report to CBD*. https://chm.cbd.int/database/record?documentID=257520

EQA (2023). *National Biodiversity Strategy and Action Plan (2023–2050)*. Ramallah: EQA. https://docs.google.com/document/d/1PB0m2ix7JK1PaMSgPwf9VGVlpnrvoIeI/edit

Ervin, J., Mulongoy, K. & Lawrence, K. (2010). *Making protected areas relevant: A guide to integrating protected areas into wider landscapes, seascapes and sectoral plans and strategies*. CBD Technical Reports. https://www.cbd.int/doc/publications/cbd-ts-44-en.pdf

Ferreira, A. F., Zimmermann, H., Santos, R. & Von Wehrden, H. (2018). A social-ecological systems framework as a tool for understanding the effectiveness of biosphere reserve management. *Sustainability*, 10(10), 3608. https://doi.org/10.3390/su10103608

Garstecki, T., Al-Rabi, T., Mahassneh, M. & Mezyed, B. (2010). *Assessment of some Palestinian nature reserves*. IUCN.

Ghattas R., Hrimat N. & Isaac J. (2005). Forests in Palestine. In: Merlo, M. & Croitoru, L., *Valuing Mediterranean forests: Towards total economic value* (Ch. 9). Editors: CABI Publishing, UK.

Görlach, B., Möller-Gulland, J., Bar-On, H. & Atrash, I. (2011). *Analysis for European Neighbourhood Policy (ENP) countries and the Russian Federation of social and economic benefits of enhanced environmental protection – Occupied Palestinian Territory Country Report*. Occupied Palestinian Territory Country Report.

Hockings, M., Hardcastle, J., Woodley, S., Sandwith, T., Wildson, J., Bammert, M., Valenzuela, S., Chataigner, B., Lefebvre, T. & Leverington, F. (2019). The IUCN Green List of Protected and Conserved Areas: Setting the standard for effective area-based conservation. *PARKS*, 25, 57–66. https://doi.org/10.2305/IUCN.CH.2019.PARKS-25-2MH.en

HSF (Hanns Seidel Foundation) (2017). *Environmental conservation and protected areas in Palestine: Challenges and opportunities.* Report by M.B. Qumsiyeh and Z. S. Amr. http://www.mahmiyat.ps/uploads/171013%20HSF_Bethlehem_Printed%20Version_NC.pdf

Jones, K. R., Venter, O., Fuller, R. A., Allan, J. R., Maxwell, S. L., Negret, P. J. & Watson, J. E. (2018). One-third of global protected land is under intense human pressure. *Science*, 360(6390), 788–791. https://doi.org/10.1126/science.aap9565

Keith, D. A., Rodríguez, J. P., Brooks, T. M., Burgman, M. A., Barrow, E. G., Bland, L., Comer, P. J., Franklin, J., Link, J., McCarthy, M. A. & Miller, R. M. (2015). The IUCN red list of ecosystems: Motivations, challenges, and applications. *Conservation Letters*, 8(3), pp. 214–226. https://doi.org/10.1111/conl.12167

Leadley, P., Gonzalez, A., Obura, D., Krug, C. B., Londoño-Murcia, M. C., Millette, K. L., Radulovici, A., Rankovic, A., Shannon, L. J., Archer, E. & Armah, F. A. (2022). Achieving global biodiversity goals by 2050 requires urgent and integrated actions. *One Earth*, 5(6), 597–603. https://doi.org/10.1016/j.oneear.2022.05.009

Levin, N. & Shmida, A. (2007). Determining conservation hotspots across biogeographic regions using rainfall belts: Israel as a case study. *Israel Journal of Ecology & Evolution*, 53, 33–58. https://doi.org/10.1560/IJEE_53_1_33

Maxwell, S. L., Cazalis, V., Dudley, N., Hoffmann, M., Rodrigues, A. S., Stolton, S., Visconti, P., Woodley, S., Kingston, N., Lewis, E. & Maron, M. (2020). Area-based conservation in the twenty-first century. *Nature*, 586(7828), 217–227. https://doi.org/10.1038/s41586-020-2773-z http://www.mopad.pna.ps/en/images/PDFs/Palestine%20State_final.pdf

Nicholson, E., Watermeyer, K. E., Rowland, J. A., Sato, C. F., Stevenson, S. L., Andrade, A., Brooks, T. M., Burgess, N. D., Cheng, S-T., Grantham, H. S., … Watson, J. E. M. (2021). Scientific foundations for an ecosystem goal, milestones and indicators for the post-2020 Global Biodiversity Framework. *Nature Ecology & Evolution*, 5(10), 1338–1349. https://doi.org/10.1038/s41559-021-01538-5

Pliscoff, P. & Fuentes-Castillo, T. (2011). Representativeness of terrestrial ecosystems in Chile's protected area system. Environmental Conservation, 38(3), 303–311. https://doi.org/10.1017/S0376892911000208

Possingham, H.P., Andelman S. J., Noon, B. Trombulak, R.S. and Pulliam, H. R. (2001), Making smart conservation decisions. *Conservation biology: research priorities for the next decade,* 23, 225-244.

Pressey, R. L., Visconti, P., McKinnon, M. C., Gurney, G. G., Barnes, M. D., Glew, L. & Maron, M. (2021). The mismeasure of conservation. *Trends in Ecology & Evolution*, 36(9), 808–821. https://doi.org/10.1016/j.tree.2021.06.008

Qumsiyeh, M. B. & Abusarhan, M. (2021). Biodiversity and environmental conservation in Palestine. In: Öztürk, M., Altay, V. &Efe, R. Efe (Eds.), *Biodiversity conservation and sustainability in Asia. Vol. 1. Prospects and challenges in West Asia and Caucasus* (pp. 1–22). Switzerland: Springer Nature.

Qumsiyeh, M. B. & Albardeiya, I. M. (2022). Politics, power, and the environment in Palestine. *Africana Studia* 37, 73–82.

Qumsiyeh, M. B. & Amr, Z. S. (2016). Protected areas in the Occupied Palestinian Territories. *Jordan Journal of Natural History*, Special issue 1,(3), 25–46.

Qumsiyeh, M. B., Bassous-Ghattas, R., Handal, E. N., Abusarhan, M., Najajreh, M. H. & Albaradeyiyah, I. M. (2023). Biodiversity Conservation of a new protected area 'Al-Arqoub', South Jerusalem, Palestine. *PARKS*, 29, 33–42. https://doi.org/10.2305/IUCN.CH.2023.PARKS-29-1MBQ.en

Qumsiyeh, M. B., Handal, E. N., Al-Sheikh, B. Najajreh, M. H. & Albaradeiya, I. M. (2022). Designating the first vernal pool microreserve in a buffer zone of Wadi Qana protected area, Palestine. *Wetlands*, 42, 119. https://doi.org/10.1007/s13157-022-01644-5

Qumsiyeh, M. B., Khalilieh, A., Albaradeiya, I. M. & Al-Shaikh, B. (2016). Biodiversity conservation of Wadi Al-Quff protected area (Central Palestine): Challenges and opportunities. *Jordan Journal of Natural History*, Special issue 1, 3, 6–24.

Qumsiyeh, M. B. McHugh, C., Shaheen, S. & Najajrah, M. H. (submitted). *Bio-cultural landscape and eco-friendly agriculture in Al-Arqoub, South Jerusalem, Palestine*.

Radford, E. A., Catullo G. & de Montmollin, B. (Eds.) (2011). Important plant areas of the south and east Mediterranean region: Priority sites for conservation. Gland, Switzerland: IUCN. https://portals.iucn.org/library/efiles/documents/2011-014.pdf

Riva, F. & Fahrig, L. (2022). The disproportionately high value of small patches for biodiversity conservation. *Conservation Letters*, 15, e12881. https://doi.org/10.1111/conl.12881

Rotem, D. & Weil, G. (2014). Natural ecosystem-units in Israel and the Palestinian authority – representativeness in protected areas and suggested solutions for biodiversity conservation. *Journal of Landscape Ecology*, 7(1), 91–109. https://doi.org/10.2478/jlecol-2014-0011

Saura, S., Bertzky, B., Bastin, L., Battistella, L., Mandrici, A. & Dubois, G. (2018). Protected area connectivity: Shortfalls in global targets and country-level priorities. *Biological Conservation*, 219, 53–67. https://doi.org/10.1016/j.biocon.2017.12.020

Schill, S., & Raber, G. (2009). Protected Area Tools (PAT) for ArcGIS 9.3TM: User Manual and Tutorial. The Nature Conservancy, 75 pp.

Tabarelli, M. & Gascon, C. (2005). Lessons from fragmentation research: Improving management and policy guidelines for biodiversity conservation. *Conservation Biology*, 19(3), 734–739. https://doi.org/10.1111/j.1523-1739.2005.00698.x

UNEP-WCMC & IUCN (2020). *Protected Planet Report: The World Database on Protected Areas (WDPA)*. Cambridge, UK. www.protectedplanet.net.

Ward, M., Saura, S., Williams, B., Ramírez-Delgado, J. P., Arafeh-Dalmau, N., Allan, J. R., Venter, O., Dubois, G. & Watson, J. E. (2020). Just ten percent of the global terrestrial protected area network is structurally connected via intact land. *Nature Communications*, 11(1), 1–10. https://doi.org/10.1038/s41467-020-18457-x

RESUMEN

La Red de Áreas Protegidas (RAP) de Palestina ha sido objeto de una evaluación y revisión exhaustivas para garantizar su eficacia en la conservación de la biodiversidad. Esta reevaluación era necesaria ya que la anterior RAP carecía de una justificación clara e incluía zonas designadas por razones no biológicas. El proceso de evaluación implicó el análisis de las 50 áreas del PAN anterior, así como la realización de un análisis de Marxan y la incorporación de nuevos datos basados en los criterios de la UICN. El proceso de evaluación llevó a eliminar, combinar y ajustar áreas, lo que dio como resultado un PAN revisado compuesto por 28 áreas. Esta PAN actualizada representa todos los tipos de vegetación y zonas fitogeográficas de Palestina, protegiendo eficazmente las ecorregiones clave del punto caliente mediterráneo. La revisión del PAN ha aumentado la masa terrestre total protegida del 9% al 9,98%. Esta ampliación proporciona zonas adicionales donde la biodiversidad puede prosperar sin perturbaciones, garantizando la supervivencia a largo plazo de especies y ecosistemas. El PAN actualizado fue aprobado al más alto nivel gubernamental, lo que significa la importancia y el compromiso con la conservación de la biodiversidad en Palestina. Este logro demuestra los progresos realizados por Palestina en la salvaguarda de su patrimonio natural.

RÉSUMÉ

Le réseau de zones protégées (PAN) en Palestine a fait l'objet d'une évaluation et d'une révision complètes afin de garantir son efficacité en matière de conservation de la biodiversité. Cette réévaluation était nécessaire car le PAN précédent manquait de logique claire et incluait des zones désignées pour des raisons non biologiques. Le processus d'évaluation a consisté à analyser les 50 zones du PAN précédent, à effectuer une analyse de Marxan et à intégrer de nouvelles données basées sur les critères de l'UICN. Le processus d'évaluation a permis d'éliminer, de combiner et d'ajuster des zones, ce qui a abouti à un PAN révisé composé de 28 zones. Ce PAN actualisé représente tous les types de végétation et toutes les zones phytogéographiques de Palestine, protégeant ainsi efficacement les écorégions clés du hotspot méditerranéen. La révision du PAN a permis d'augmenter la masse terrestre protégée totale de 9 % à 9,98 %. Cette expansion fournit des zones supplémentaires où la biodiversité peut se développer sans être perturbée, assurant ainsi la survie à long terme des espèces et des écosystèmes. Le PAN actualisé a été adopté au plus haut niveau du gouvernement, ce qui témoigne de l'importance de la conservation de la biodiversité en Palestine et de l'engagement pris à cet égard. Cette réalisation démontre les progrès accomplis par la Palestine dans la sauvegarde de son patrimoine naturel.