STILL WATER REVIVAL
Restoring and conserving
still water ecosystems of
Mediterranean karst mountains

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Criteria and Protocol for Restoration Prioritization of Small Freshwater Ecosystem Units (SFEU) (activity A4)

Final version

Activity description

Freshwater ecosystems are defined primarily by their hydrology, pedology and vegetation, and the assessment of their status is based on understanding the factors that enable the creation and persistence of these ecosystems in a specific environment (Fennessy et al. 2007). The ecological assessment of SFEU (A2) is based on criteria that reflect the basic factors defining freshwater ecosystems, as well as the threats that limit their functionality. All criteria have a range of points and the sum of this points for represents the ecological status of SFEU.

Extremely degraded (bad integrity)

Highly functional (good integrity)

Rationale

The goal of this activity is to define prioritization criteria for restoration of SFEU, using data acquired during the activity *„A3 Spatial and biological quality assessments of SFEU within Dinara area*". In the A3 activity, for each SFEU we performed a structural and ecological assessment (A2 methodology) and mapped its location. Prioritization can be seen as a tool that enables us to make informed decisions about which SFEU to restore when we have limited resources, in order to maximize the benefits while keeping in mind the **aim of restoration** – preventing the permanent loss of freshwater ecosystems and the biodiversity dependent on them and preservation of source of freshwater for wild and domestic animals in rural and remote areas.

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The restoration is based on the following principles:

1. prioritization should encompass SFEU in the project area, whose restoration will create and increase the biodiversity of freshwater ecosystems the most;
2. SFEU that will benefit the highest number of stakeholders should be restored;
3. restoration requires an acceptable level of effort to reach high functionality of freshwater ecosystems.

According to the above principles, the criteria for prioritization are divided into 3 categories (**ecological**, **socio-economic** and **structural**) and each category is first scored separately. Then the value of each category is multiplied by a weighting factor according to the arbitrarily defined importance of each category (ecological x 0.5, socio-economic x 0.3, structural 0.2) and the sum for weighted values of these 3 categories is the final value that represents the priority for restoration, with the highest final value indicating the highest priority.

Prioritization essentially being a tool, it is up to the user to decide how much weight it will give to the prioritization results. They can be taken at face value, or the final choice of SFEU to be restored can be a combination of different arguments where prioritization result is just one of them.

As the 3 groups of criteria are scored separately, it if possible to know, for each SFEU, which group contributes the most to its final value, and that can also be used in the decision-making process (i.e. if the focus for restoration changes). In the same way, it is possible to find out which criteria contributes the most for the group score, and which criteria are interconnected (i.e. the absence of water has a direct negative impact on many criteria).

Furthermore, as the historical development and usage of SFEU is area specific and reflects the environmental and cultural factors present then and now, not all criteria may be applicable be used in all karstic mountains. There are some criteria that are essential for the prioritization process to be useful (criteria about the preservation of SFEU), while others criteria are optional and can add to the quality of the process. Nevertheless, it is advisable to use all the criteria provided if it is possible, as in that way the groups are balanced and the final result of the prioritization adequately reflects all 3 principles listed above.

The criteria for prioritization of SFEU restoration are listed below.

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Criteria (essential criteria are bolded)

Criteria type	Criteria name	Description	Value Type	Final Value
Ecological	**(E1) Ecological status of SFEU**	The more the score differs from the ideal value (maximum – 32), the higher the priority for restoration. A SFEU with a score of 32 does not need any restoration as it already has the ideal ecological status.	Index (0,0-1,0)	For each SFEU we take the value obtained thorough activity A2 (-6 to 32) and divide it by the maximum value (32). To get the final value, we subtract 1 an get an index (values between 0,0-1,0).
	(E2) Possibility of successful restoration	We estimate the probability of a successful restoration from the ecological point of view (achieving category IV. or V. in 5 years after restoration) –A2 score > 18.	Binary (YES/NO)	YES - 1 NO - 0
	(E3) Presence of Natura 2000 species	We estimate the possibility of the presence of one or more Natura 2000 species (weather the species use the SFEU), making a SFEU a priority for restoration.	Binary (YES/NO)	YES - 1 NO - 0
	(E4) Possibility of a negative impact	If the restoration work would lead to a permanent loss of a significant negative impact to the flora, fauna and/or habitats of the SFEU, then this SFEU is not a priority for restoration. If the SFEU is having a maximum number of points in 3 categories of A2 (7. Number of vegetation layers; 8. Presence of different groups of herpetofauna; 9. Presence of dragonflies), and there is a need for mechanization in the restoration process, it is estimated that there is a possibility of a significant negative impact.	Binary (YES/NO)	YES - 0 NO - 1
	(E5) Possibility of SFEU loss	If we estimate that the SFEU will be permanently lost in the next 10 years if no restoration is carried out, it is a priority for restoration.	Binary (YES/NO)	YES - 1 NO - 0
Socio-economic	(P1) Long-term viability of restoration	If the environmental factors indicate a possibility for degradation of the SFEU in the next 20 years, the priority for restoration is low. All SFEU located above 1000m above sea level are deemed less viable for restoration in the long term.	Binary (YES/NO)	YES - 0 NO - 1
	(P2) Number of different users of SFEU	If the SFEU is used by multiple stakeholders (i.e. Hikers, hunters), it is used for different activities (i.e. Potable water, observing nature) and is used by wild animals, it is considered a priority for restoration.	Index (0,0-1,0)	Number of users give a value (potential users after restoration are also included) that is divided by the highest value among the SFEU, to get an index (0,0-1,0)
	(P3) Isolation	If there are no other sources of water in the radius of 2km from the SFEU, it is a priority for restoration.	Binary (YES/NO)	YES - 1 NO - 0
	(P4) Water need	If the SFEU is located on an area where the stakeholders have expressed the need for water, it is a priority for restoration (if there is no data available, it is assumed that there are no water needs for the area)	Binary (YES/NO)	YES - 1 NO - 0

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Criteria type	Criteria name	Description	Value Type	Final Value
	(P5) Logistical complexity	If access to the SFEU is logistically demanding or its surrounding have specific characteristics that makes it hard to carry out the restoration work, it is not a priority for restoration.	Binary (YES/NO)	YES - 0 NO - 1
Structural	**(S1) Size of SFEU**	Size of the area and the length of the coast – the bigger they are more animals/people can use the SFEU	Index (0,0-1,0)	Assess the radius and circumference of SFEU (in meters) and sum the values. The final value is an index (0,0-1,0) calculated by dividing the sum with the highest sum from the SFEU used in the prioritization.
	(S2) Risk of traffic accidents	If the SFEU is located in the vicinity of an asphalted road that has a lot of traffic, restoration could increase the possibility of traffic accidents with wild animals, if they use the SFEU. The risk is estimated according to expert knowledge (if it is not available, any SFEU 500m from an asphalt road can be considered a risk).	Binary (YES/NO)	YES - 0 NO - 1
	(S3) Loss of water retention	If there is a risk of permanent loss of water retention of the SFEU in the near future, it is a priority for restoration.	Binary (YES/NO)	YES - 1 NO - 0
	(S4) Restoration difficulty	The estimation of restoration difficulty is based on expert knowledge, and considers if the restoration requires the use of mechanization or it is possible to restore SFEU using just manual labour.	Binary (YES/NO)	Mechanization needed (YES) - 0 No mechanization (NO) - 1
	(S5) Logistical availability	If the SFEU is located in the vicinity of an asphalt road (in a radius of 1000m), or is located bellow 1000m of altitude, it is considered as logistically available and a priority for restoration.	Binary (YES/NO)	YES - 1 NO - 0

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Protocol

1. Use the data acquired through the A2 activity

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2. Fill the A4 form for each SFEU for which you assess a need for restoration.

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3. Get a total of points for each group of criteria separately (ecological, socio-economic, structural)

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4. Multiply the total points of each group with the appropriate weight (ecological– 0.5, socio-economic– 0.2, structural – 0.3)

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5. The final value is the weighted sum of points of all three groups of criteria. The higher the value of a SFEU, it is considered a higher priority for restoration (the values are relative and do not necessarily reflect reality as are based on observational assessment)

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6. Descriptive criteria (marked by * in the form) can be used as an additional source of information for making a final decision in the choice of SFEU for restoration, since the final value does not represent an absolute value for priority for restoration, but a tool for a more objective decision-making process.