ACTION A4. ANALYSIS AND MAPPING OF EXISTING CROSSING STRUCTURES FOR POTENTIAL USE BY THE TARGET SPECIES AND OTHER INTERVENTIONS ON THE ROADS.

ACTION REPORT/2020 – Majella National Park

LIFE SAFE CROSSING
PREVENTING ANIMAL-VEHICLE COLLISIONS

Parco Nazionale della Majella

SUMMARY

OBJECTIVES

Action A4 is one of the preliminary Actions of the Life Project Safe-Crossing and, together with Actions A3 and A5, allows the collection of data necessary to plan the possible interventions needed in the frame of C actions. Specifically, Action A4 is preliminary to Action C2 and its main objective is to identify existing crossing structures that, implementing any possibly needed adaptation, could be used by the Apennine brown bear. To achieve this general objective, in the Majella National Park (PNM) the following specific objectives have been pursued:

- Mapping and characterization of the existing crossing structures
- Individuation of the crossing structures potentially suitable by bears
- Assessment of the actual current use by animals
- Individuation of interventions needed

The aim of this document is both to report activities developed and to present results of Action A4. However, to plan interventions to be realized in the frame of C actions, data collected with Action A4 have been evaluated together with results from Action A3 and A5.

STUDY AREA

PNM study area for the Life Safe-Crossing includes both roads inside and outside the Park boundary. Action A4 in PNM was foreseen to be implemented along specific segments of the roads SS487 (inside the Park), SS5 and SS17 (outside the Park). However, given the availability of dedicated personnel and financial resources in the Travel costs, the actual A4 monitoring area has been extended adding new roads (SS84, SP12, SP54, SP55 and SP84) and adding new segments of SS5, SS17 and SS487 as well (Table 1, Figure 1). A total of 201 Km have thus been monitored against the 79.2 foreseen in the project (Table 1).

Table 1. Roads and km/road actually monitored in the frame of Action A4 compared to what foreseen in Action A4 in the Majella National Park, Central Italy.

*** Entire road length**

**** 15.7 Km added in 2020**

Road code	Km foreseen in the project	Km actually monitored
SS 5	6.5	14.8
SS17	59.5	59.5
SS 84	0	5.8
SS 487	13.2	57.1**
SP 12	0	22.4*
SP 54	0	8.0*
SP 55	0	21.3*
SP 84	0	12.1*
Total	**79.2**	**201.0**

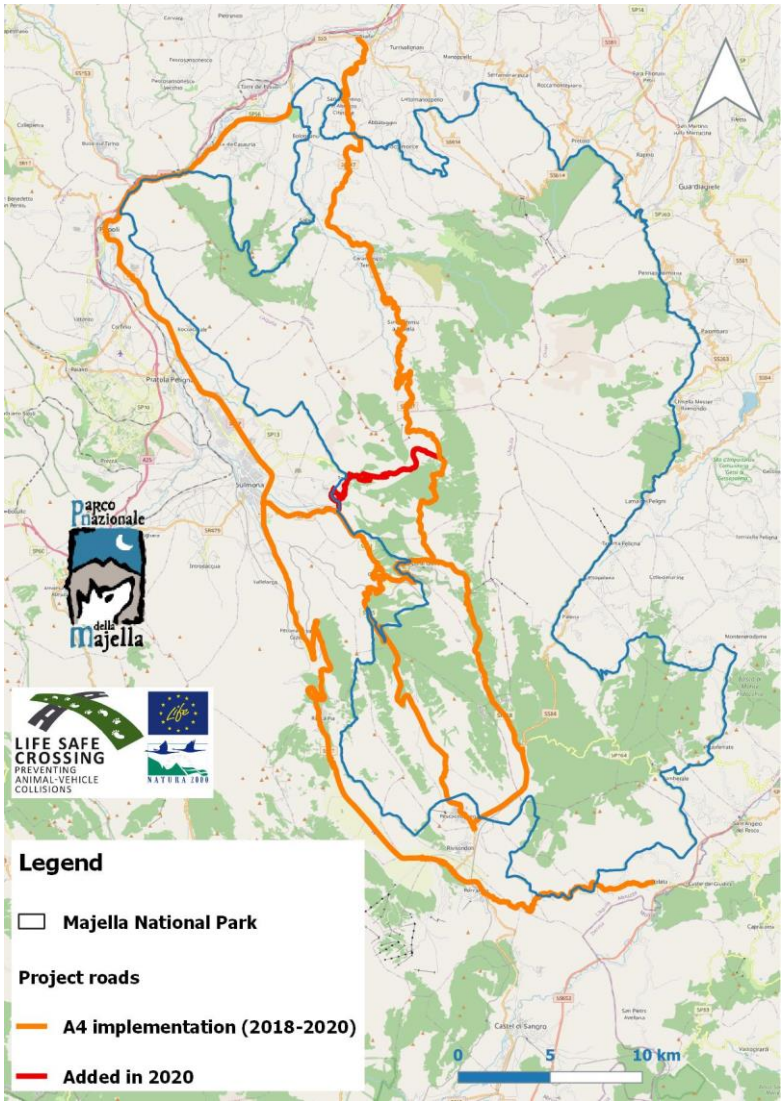


Figure 1. Roads and road segments monitored in the frame of Action A4 in the Majella National Park, Central Italy.

A 15.7 Km length segment of the SS487 road (from Passo S. Leonardo to Pacentro) has been added in the Project roads only in 2020 (Figure 1) when the road segment has been opened again to the traffic after a long period of closure due to landslides.
The objectives of implementing Action A4 in an area larger than the one reported in the Project are mainly two:

- to collect the most field data possible in order to better orientate C2 action;
- to obtain suitable data to prioritize interventions and consequently individuate both the ones to be realized during the Project and the ones to be foreseen during the After-Life period;

The choice of the roads to be added is consistent with the rationale followed by PNM to draft the Project which is the need to focus the implementation of interventions in the PNM portion where bear presence signs are concentrated and in the corridors used/to be used by bears to expand its range (Figure 2).

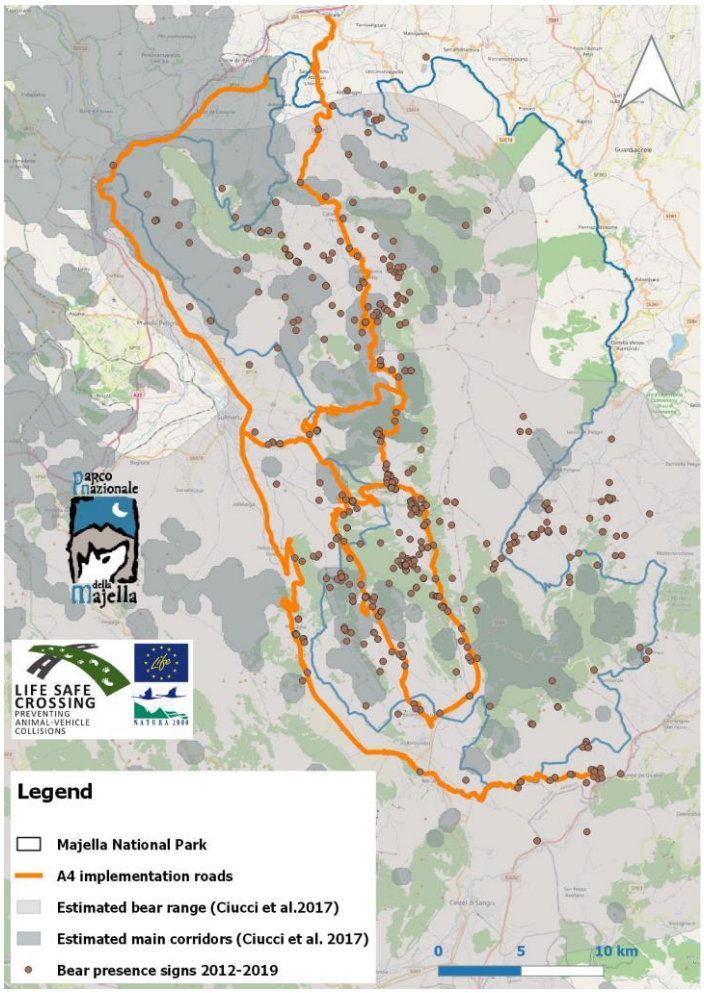


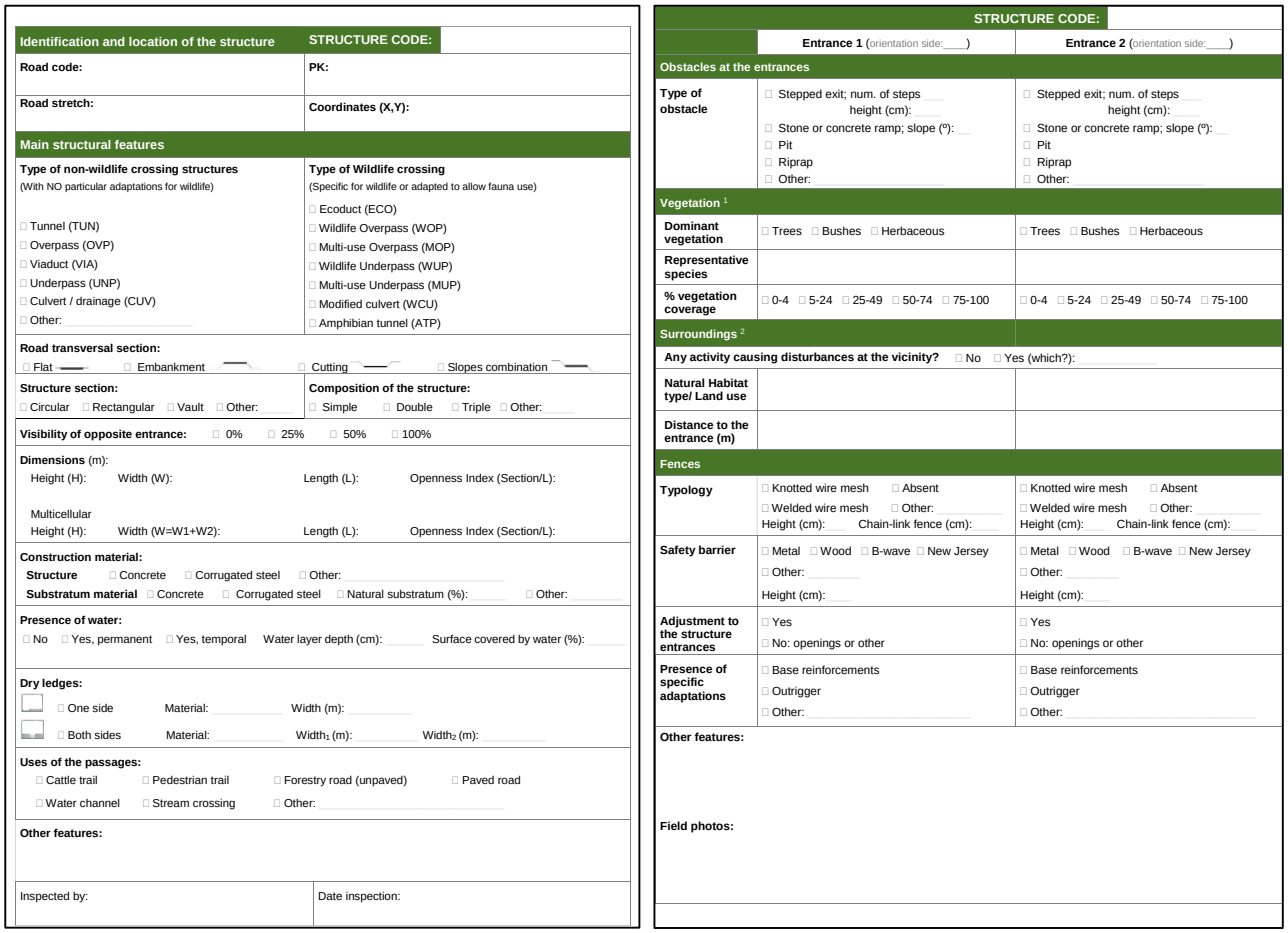
Figure 2. Roads monitored with the implementation of Action A4 in the Majella National Park, Central Italy, in relation to the estimated bear range, the estimated suitable corridors used or to be used by the Apennine brown bear to expand its range and the bear presence signs detected in the PNM monitoring area from 2012 to 2019.

METHODS

The following methods have been applied to achieve each of the above reported specific objectives:

Mapping and characterization of the existing crossing structures

Once individuated the study area, existing crossing structures have been searched for during specific field-surveys. When an underpass or an overpass was spotted, it was characterized according to the variables reported in the Project common field form elaborated by Minuartia (Figure 3). In order to avoid excluding suitable structures, all the crossing structures spotted along the roads have been characterized.



Identification and location of the structure — **STRUCTURE CODE:**

Road code: | **PK:**

Road stretch: | **Coordinates (X,Y):**

Main structural features

Type of non-wildlife crossing structures (With NO particular adaptations for wildlife)
- ☐ Tunnel (TUN)
- ☐ Overpass (OVP)
- ☐ Viaduct (VIA)
- ☐ Underpass (UNP)
- ☐ Culvert / drainage (CUV)
- ☐ Other:

Type of Wildlife crossing (Specific for wildlife or adapted to allow fauna use)
- ☐ Ecoduct (ECO)
- ☐ Wildlife Overpass (WOP)
- ☐ Multi-use Overpass (MOP)
- ☐ Wildlife Underpass (WUP)
- ☐ Multi-use Underpass (MUP)
- ☐ Modified culvert (WCU)
- ☐ Amphibian tunnel (ATP)

Road transversal section: ☐ Flat ☐ Embankment ☐ Cutting ☐ Slopes combination

Structure section: ☐ Circular ☐ Rectangular ☐ Vault ☐ Other:

Composition of the structure: ☐ Simple ☐ Double ☐ Triple ☐ Other:

Visibility of opposite entrance: ☐ 0% ☐ 25% ☐ 50% ☐ 100%

Dimensions (m):
Height (H): Width (W): Length (L): Openness Index (Section/L):
Multicellular
Height (H): Width (W=W1+W2): Length (L): Openness Index (Section/L):

Construction material:
Structure ☐ Concrete ☐ Corrugated steel ☐ Other:
Substratum material ☐ Concrete ☐ Corrugated steel ☐ Natural substratum (%): ☐ Other:

Presence of water:
☐ No ☐ Yes, permanent ☐ Yes, temporal Water layer depth (cm): Surface covered by water (%):

Dry ledges:
☐ One side Material: Width (m):
☐ Both sides Material: Width$_1$ (m): Width$_2$ (m):

Uses of the passages:
☐ Cattle trail ☐ Pedestrian trail ☐ Forestry road (unpaved) ☐ Paved road
☐ Water channel ☐ Stream crossing ☐ Other:

Other features:

Inspected by: | Date inspection:

STRUCTURE CODE:

	Entrance 1 (orientation side:___)	**Entrance 2** (orientation side:___)
Obstacles at the entrances		
Type of obstacle	☐ Stepped exit; num. of steps ___ height (cm): ___ ☐ Stone or concrete ramp; slope (º): ___ ☐ Pit ☐ Riprap ☐ Other:	☐ Stepped exit; num. of steps ___ height (cm): ___ ☐ Stone or concrete ramp; slope (º): ___ ☐ Pit ☐ Riprap ☐ Other:
Vegetation [1]		
Dominant vegetation	☐ Trees ☐ Bushes ☐ Herbaceous	☐ Trees ☐ Bushes ☐ Herbaceous
Representative species		
% vegetation coverage	☐ 0-4 ☐ 5-24 ☐ 25-49 ☐ 50-74 ☐ 75-100	☐ 0-4 ☐ 5-24 ☐ 25-49 ☐ 50-74 ☐ 75-100
Surroundings [2]		
Any activity causing disturbances at the vicinity? ☐ No ☐ Yes (which?):		
Natural Habitat type/ Land use		
Distance to the entrance (m)		
Fences		
Typology	☐ Knotted wire mesh ☐ Absent ☐ Welded wire mesh ☐ Other: Height (cm): ___ Chain-link fence (cm): ___	☐ Knotted wire mesh ☐ Absent ☐ Welded wire mesh ☐ Other: Height (cm): ___ Chain-link fence (cm): ___
Safety barrier	☐ Metal ☐ Wood ☐ B-wave ☐ New Jersey ☐ Other: Height (cm):	☐ Metal ☐ Wood ☐ B-wave ☐ New Jersey ☐ Other: Height (cm):
Adjustment to the structure entrances	☐ Yes ☐ No: openings or other	☐ Yes ☐ No: openings or other
Presence of specific adaptations	☐ Base reinforcements ☐ Outrigger ☐ Other:	☐ Base reinforcements ☐ Outrigger ☐ Other:

Other features:

Field photos:

Figure 3. Common field form provided by Minuartia and used to characterize crossing structures in the Project area of the Majella National Park, central Italy, in the Life Safe-Crossing.

Individuation of the crossing structures potentially usable as wildlife crossings

Once crossing structures have been characterized, the selection-process to individuate the ones usable as wildlife crossings, and particularly the ones with highest probability of being used by bears, followed the logical frame reported in the guidelines produced by Minuartia in the frame of Action A4. Specifically, three levels have been evaluated for each structure: location, dimension and purpose of the structure (Table 2).

Table 2. Summary of criteria elaborated by Minuartia with Action A4 of the Life Safe-crossing for the selection of the crossing structures with higher probability of being used by bears.

Level	Criterion	Value/description
Location	Surrounding habitats	High quality, ecological meaning, absence of human disturbance
	Mortality	Presence of AVC clusters
	Bear presence data	Presence data and telemetry hot spots
Dimension	Width	≥ 15 m
	Height	≥ 3.5 m
	Openness index	≥ 0.75
Use	Avoid crossing structures with paved roads	

Dimension criteria suggested by Minuartia are, as declared by the authors themselves, highly conservative and suffer the lack of literature references concerning crossing structures use by bears. Basing on our experience and knowledge, we believe that bears actually can pass through very small structures (the smallest observed is 37 cm height), however we also believe that the smaller the structure the strongest must be the benefit in using it (i.e. a small structure in high-traffic road could be used more than the same structure in a low-traffic isolated road). Considering these difficulties in evaluating dimension suitability, considering that several factors need to be taken into account when identifying potentially suitable crossing structures and considering also that it can be difficult to assess which factor is more important than others, we've decided to elaborate a synoptic table reporting criteria accomplishment for each level and for each crossing structure. In the synoptic table the following data are reported:

a) Surrounding habitats: the evaluation of habitat quality around crossing structures is a tricky issue and strongly depends on how habitat availability is quantified around the structures themselves. To perform an habitat quality evaluation consistent with the literature on Apennine brown bear, we therefore decided to analyze the crossing structure location in relation to suitability models elaborated by Ciucci et al. (2017). Distance from suitable areas and distance from corridors are thus the two variables used to express habitat quality in the surrounding areas. In order to add a fine scale evaluation, the ecological meaning of the structure has also been evaluated using the variable “fine scale location” (categorized in “relevant” or “not relevant”) to distinguish crossing structures located along preferential movement lines (e.g. valleys) from the ones randomly located. Finally, the presence of human disturbance has been expressed as “yes” or “no” basing on the presence of settlements or other impacting human activities.
b) Mortality: presence of AVC clusters near to crossing structures clearly indicates that AVC mortality could be reduced augmenting, if possible, the crossing structure suitability. This concept has been expressed in the synoptic table with the variable “Relevant to reduce AVC mortality” categorized as “yes” or “no”. All the crossing structures falling in a AVC cluster or in a road segment between 2 or more AVC clusters have been categorized as “yes”. Additionally, considering that AVC clusters have been elaborated (in the frame of Action A3) from a dataset affected by false negatives, the GIS-based evaluation of this variable has been combined with expert-based evaluations assigning value “yes” to additional structures.
c) Bear presence data: considering that roads included in the PNM study area are the ones falling into the most important bear presence areas, all the crossing structures must be considered in relevant locations as a default characteristic. However, some crossing structures could be located in areas particularly frequented by bears or where particular events happened (e.g. bear observations on the road) so that the variable “Bear presence highlight”, categorized as “yes” or “no”, has been included in the table as well.
d) Dimension level: Width, height and openness indexes have been reported in the table highlighting the crossing structures with openness indexes ≥ 0.75.
e) Use: the use of the crossing structure has been reported in the table and the ones with paved roads have been highlighted as “not suitable”.

Once constructed the synoptic table assigning variable values to each crossing structure, a specific method to exclude the unsuitable ones and prioritize potentially suitable structure was applied (Figure 4).

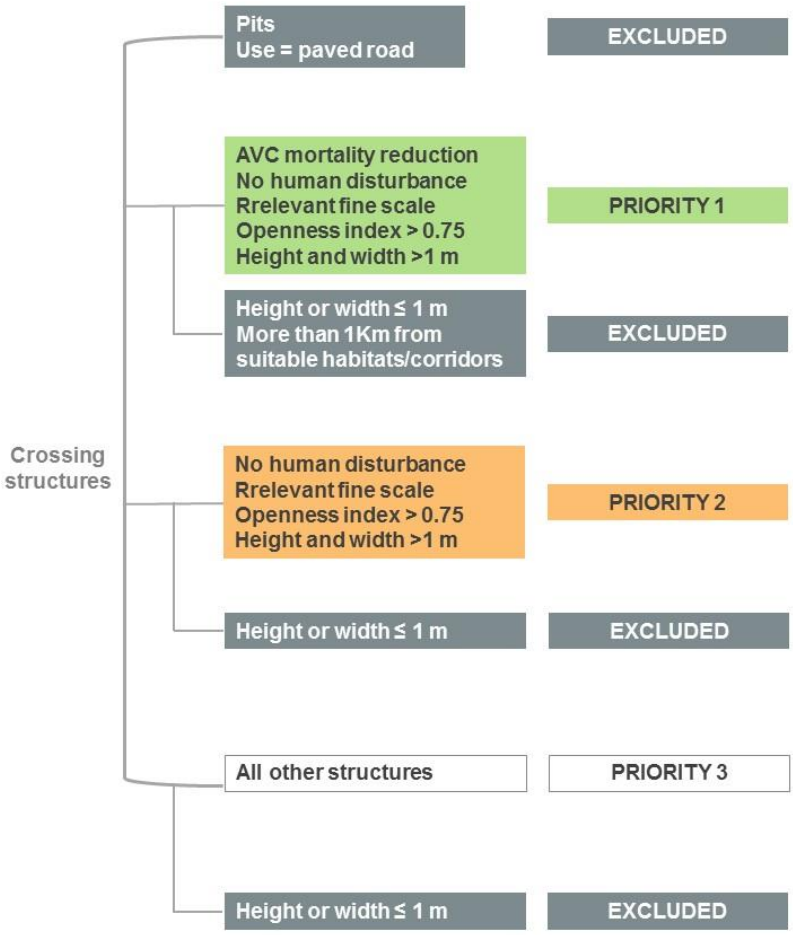


Figure 4. Method followed to exclude unsuitable crossing structures and to prioritize the suitable ones within the 87 crossing structures characterized in the Majella National Park Project area in the frame of Action A4 of the Life Safe-Crossing.

Priority 1 was thus assigned to structures relevant in reducing AVC mortality, without human disturbance, in relevant locations at the fine scale level, with suitable dimension (i.e. accomplishing Minuartia suggestion or having height and width >1m) and at a distance from suitable areas/corridors ≤ 1Km. Priority 2 was assigned to the structures having the same characteristics of priority 1 structures except that they are located in areas where the correlation with AVC mortality is less clear. Priority 1 and priority 2 structures have been considered the only candidates for interventions foreseen in Action C2 while priority 3 structures have been considered candidates for possible additional

interventions in the frame of the Life Safe-Crossing, the After-Life or any possible future road ecology Project.

Assessment of the actual current use by animals

The current use by animals has been assessed in two ways. First, presence signs have been searched for during the characterization survey and second camera trapping sessions have been implemented. The recording of presence signs during field surveys has been implemented using the common field-form provided by Minuartia (Figure 5).

STRUCTURE CODE:		
Fauna registers during inspection (Mark the species detected in each location; add the traces observed as: F: Footprint; E: Excrement; D: Direct observation)		
Inside the passage	**Outside the passage**	
	Entrance 1 (orientation side:____)	**Entrance 2** (orientation side:____)
☐ Micromammal	☐ Micromammal	☐ Micromammal
☐ Rabbit ☐ Hare	☐ Rabbit ☐ Hare	☐ Rabbit ☐ Hare
☐ Fox ☐ Badger ☐ Marten ☐ Stone marten ☐ Otter ☐ Genet	☐ Fox ☐ Badger ☐ Marten ☐ Stone marten ☐ Otter ☐ Genet	☐ Fox ☐ Badger ☐ Marten ☐ Stone marten ☐ Otter ☐ Genet
☐ Brown bear ☐ European lynx ☐ Iberian lynx ☐ Wolf ☐ Wild cat	☐ Brown bear ☐ European lynx ☐ Iberian lynx ☐ Wolf ☐ Wild cat	☐ Brown bear ☐ European lynx ☐ Iberian lynx ☐ Wolf ☐ Wild cat
☐ Wild boar ☐ Roe deer ☐ Red deer ☐ Fallow deer	☐ Wild boar ☐ Roe deer ☐ Red deer ☐ Fallow deer	☐ Wild boar ☐ Roe deer ☐ Red deer ☐ Fallow deer
☐ Dog ☐ Cat	☐ Dog ☐ Cat	☐ Dog ☐ Cat
☐ Other: _____	☐ Other: _____	☐ Other: _____

Figure 5. Common field form provided by Minuartia and used to assess actual use by wildlife of the crossing structures present in the Majella National Park Project area.

Crossing structures to be object of camera trapping have been selected with the same process used to individuate crossing structures potentially usable as wildlife crossing having priority 1 or 2, applying two additional steps:

- evaluation of the structure accessibility: during characterization surveys some of the crossing structures resulted really hard-to-access due to the presence of dense vegetation. Such structures are impossible to monitor with camera traps but a “no use” classification was still possible due to the clear absence of paths in the dense tangled vegetation.
- evaluation of the theft risk: camera trapping thefts have become a major issue in the Majella National Park and, particularly, in the last 3 years the percentage of stolen camera traps abruptly augmented being, in some areas, 100% of the camera traps installed. When the evaluation of the theft risk was classified as high, no camera traps have been installed.

Data collected with the camera trapping have been entered in the Excel database format provided by the coordinating beneficiary.

Individuation of interventions needed

Database referring to structures assigned to priority 1 and 2 has been evaluated in order to understand which interventions are needed to make crossing structures usable by wildlife and especially by bears. The evaluation of adaptations needed followed the guidelines provided by Minuartia and, particularly, the following steps have been taken:

- the actual structures characteristics have been compared to the ideal ones provided in Annex I of the document produced in the frame of Action A4 (Guidelines to adapt transversal structures and increase use by large carnivores and other wildlife).

- Features that can be modified with moderate costs (substratum, obstacles, vegetation, fencing) have been analysed. Human disturbance features have not been analysed as priority 1 and priority 2 structures are the ones already classified as “without human disturbance”. However, presence of fine scale disturbances like lights and noises will be evaluated during Action C2 to draft the final intervention plan.

A summary table with the list of crossing structures and the related interventions needed has thus been drafted.

RESULTS

Mapping and characterization of the existing crossing structures

From 5/06/2019 to 13/09/2019, 9 field surveys have been developed during which 87 crossing structures have been characterized (mean, min-max: 10, 1-24 structures/day) representing 100% of the structures present along the chosen roads.

Table 3. Summary of the number, type, dimension and location in either National or Province roads of the 87 crossing structures characterized in the Majella National Park Project area during Action A4 of the Life Safe-Crossing.

* **6 Underpasses and 1 culvert have only one entrance and the other one represented by pits.**

Type of Structure	N (%)	Mean (± SD) Openness Index	Mean (± SD) length (m)	N National roads (%)	N Province roads (%)
Culvert*	7 (8%)	0.10 (± 0.05)	9.86 (± 4.74	6 (86%)	1 (14%)
Underpass*	59 (68%)	1.35 (± 3.16)	8.44 (± 3.9)	38 (64%)	21 (36%)
Overpass	7 (8%)	-	14 (±1.53) L 226 (± 276) W	7 (100%)	0 (0%)
Viaduct	14 (16%)	-	9.42 (±1.24)	13 (93%)	1 (7%)

The most abundant crossing structure found is the underpass (68%), followed by viaduct (16%) culvert and overpass (7% each) (Table 3). Overpasses are only present along National roads, viaducts and culverts are mainly present along National roads while underpasses are present along both roads (Table 3, Figure 6). All data collected according to the field-form have been entered in the Excel format database provided by the coordinating beneficiary; a detailed table reporting data on dimension and use of the

crossing structures characterized is reported in **Annex I** and, additionally, all the relevant data and the pictures have been reported in a specific document sent separately to the coordinating beneficiary (PNM crossing structures catalogue PDF).

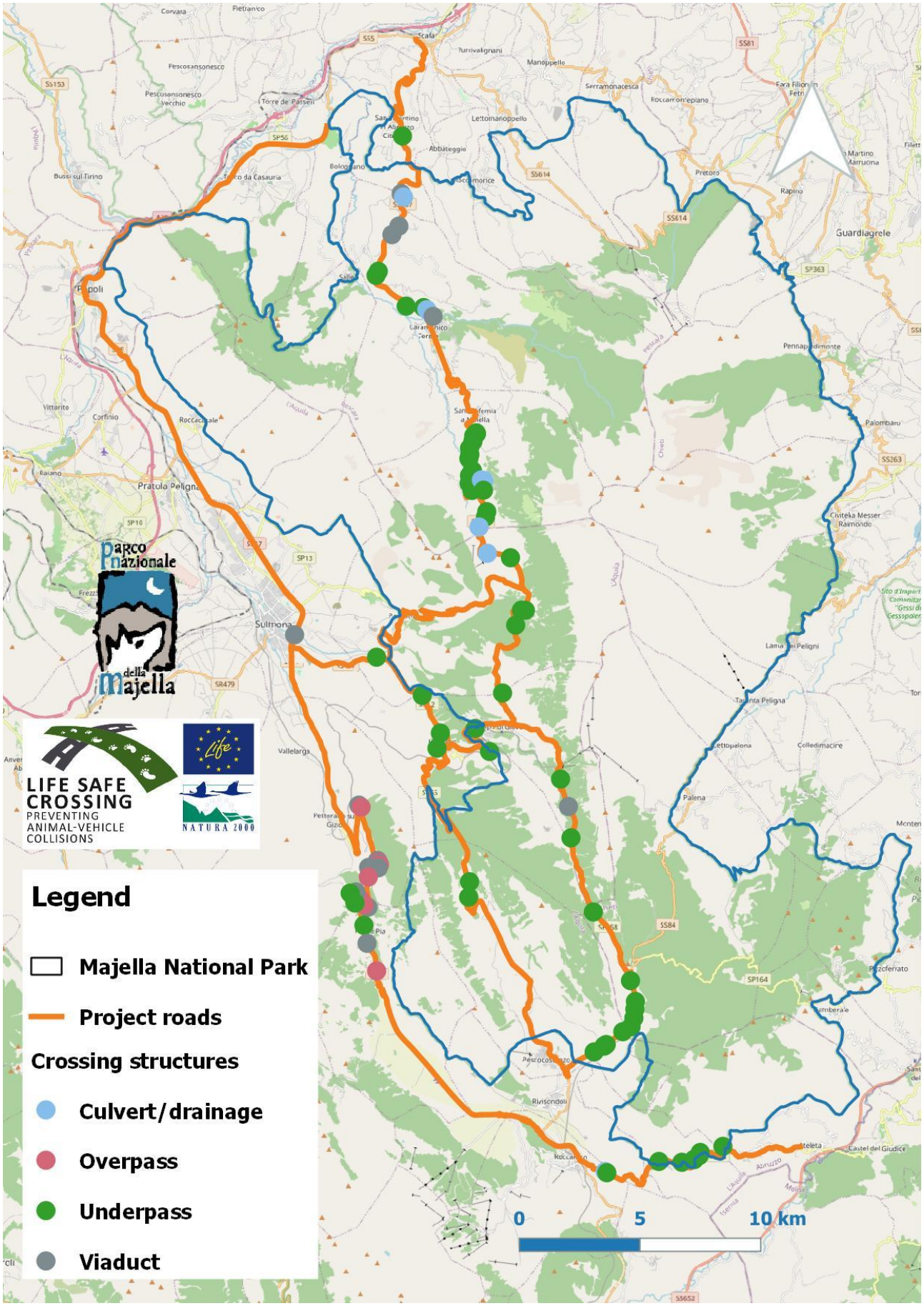

LIFE SAFE CROSSING
PREVENTING ANIMAL-VEHICLE COLLISIONS
Parco Nazionale della Majella
Legend
Majella National Park
Project roads
Crossing structures
Culvert/drainage
Overpass
Underpass
Viaduct
0
5
10 km

Figure 6. Location and type of the 87 crossing structures characterized in the Majella National Park Project area during the implementation of Action A4 of the Life Safe-crossing.

Individuation of the crossing structures potentially usable as wildlife crossings

The application of the selection method led to the exclusion of 16 crossing structures (7 pits, 1 viaduct used for a paved road, 8 culverts/underpasses with height or width ≤ 1m, Figures 7-8, Table 4). Twenty structures resulted as priority 1, 15 as priority 2 and 36 as priority 3 (Figures 7-8, Table 4).

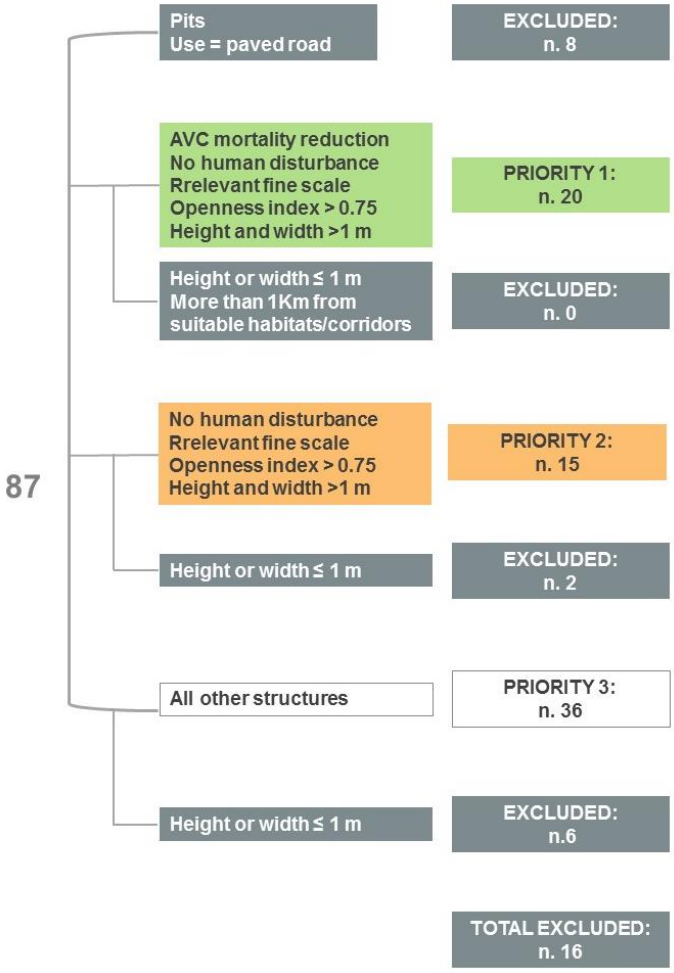


Figure 7. Results of the selection process aimed at excluding unsuitable crossing structures and prioritizing the suitable ones within the 87 structures characterized in the Majella National Park Project area in the frame of Action A4 of the Life Safe-Crossing.

The majority of AVC clusters identified with action A3 fall in road segments where no crossing structures are present. However, two road segments resulted as interested by both AVC clusters and crossing structures presence.

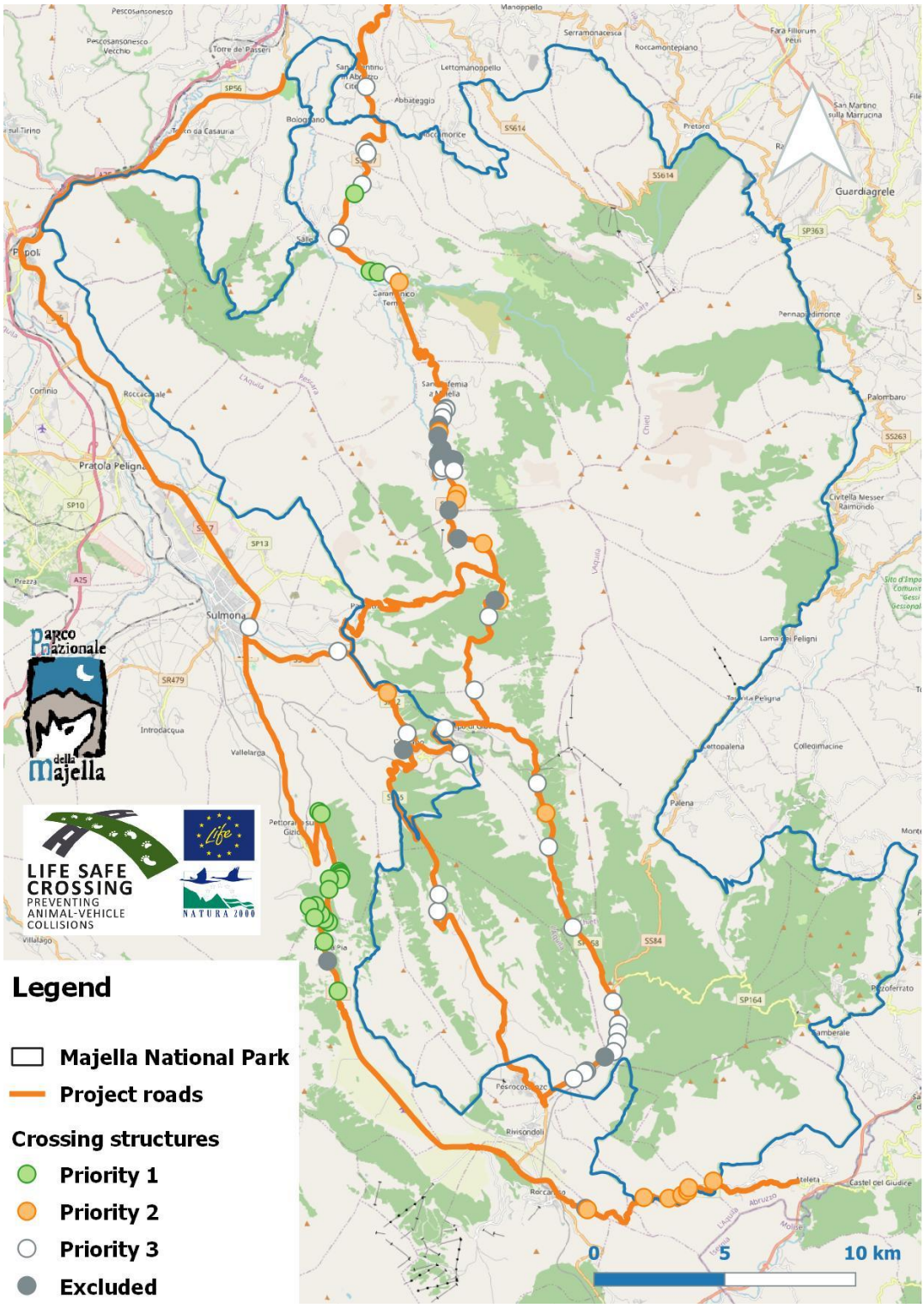


Figure 8. Classification of the crossing structures characterized in the Majella national Park Project area in the frame of Action A4 of the Life Safe-Crossing in relation to the possibility of use them as wildlife crossing structure with a probability of being used by bears.

A road segment between Caramanico Terme and S.Valentino A.C., along the SS487, resulted as one of the most affected by AVC risk being interested by the presence of 4 AVC clusters (50% low sureness and 50% high sureness, Figure 9)

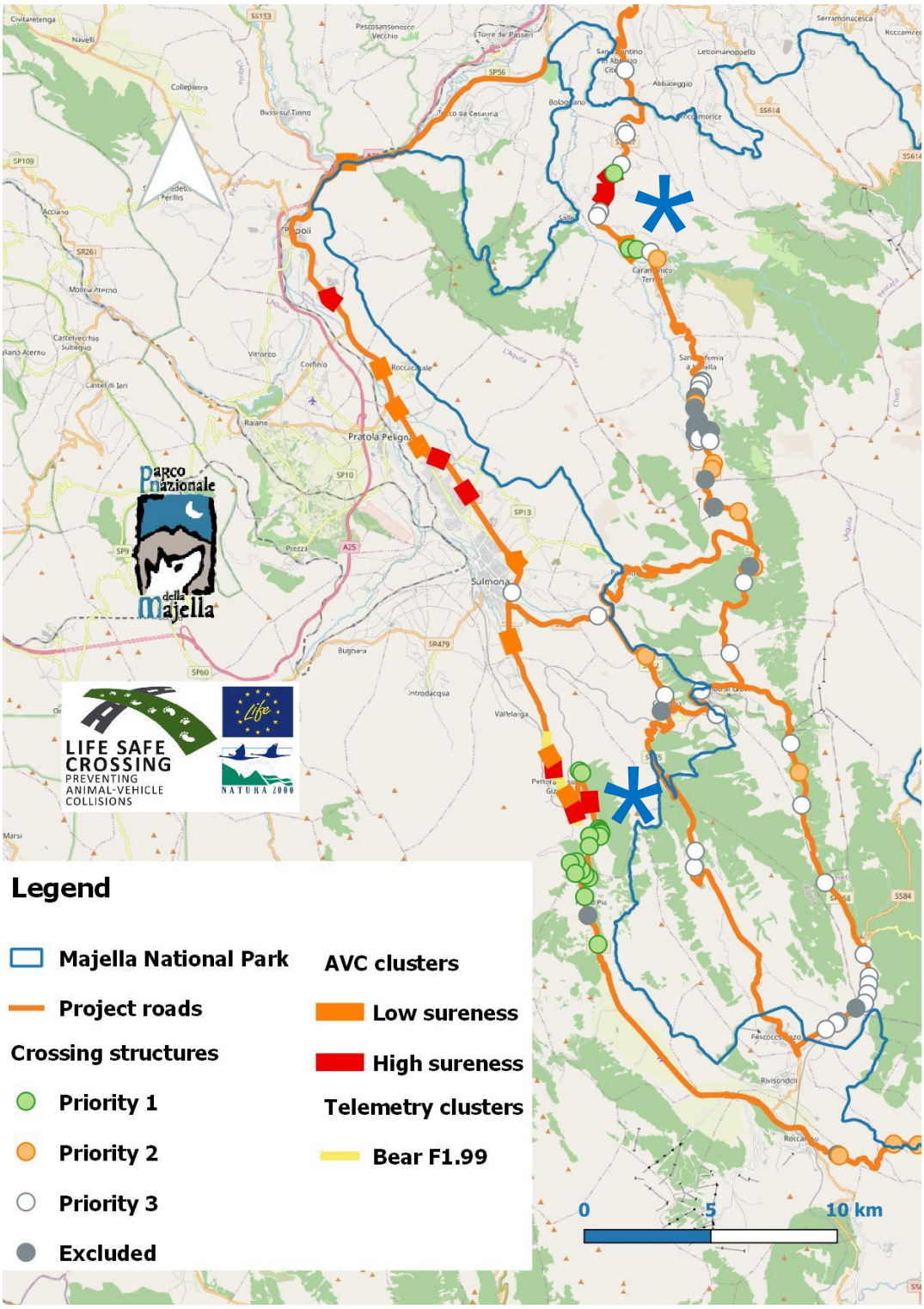


Figure 9. Location of the crossing structures characterized in the Majella National Park Project area in relation to AVC clusters and telemetry clusters identified in the frame of Action A3 of the Life Safe-Crossing. Blue asterisks individuate the two segments with both AVC/telemetry clusters and crossing structures presence.

Table 4. Synoptic table elaborated to prioritize crossing structures suitability as wildlife crossings basing on location, dimension and use. Data collected in the frame of Action A4 of the Life Safe-Crossing in the Majella National Park Project area. Green = priority 1; orange = priority 2; white = priority 3; grey = excluded. Variables implying favorable conditions to consider the crossing structure a good wildlife (bear) passage are reported in bold.

Structure code	Road code	Type of crossing structure	Distance from suitable areas (m)	Distance from corridors (m)	Fine scale location	Human disturbance	Height (m)	Width (m)	Length	Openness index	Uses of the passages	Relevant to reduce AVC mortality	Bear presence highlight
UNP_SP12_CGP+01	SP12	Underpass	**0**	4259	Not relevant	yes	2.20	1.60	8.00	0.13	Water channel	No	**Yes**
UNP_SP12_CGP+03	SP12	Underpass	**0**	2594	Not relevant	**No**	3.50	4.00	7.60	**0.83**	Water channel	No	**Yes**
UNP_SP12_CGP+04	SP12	Underpass	**0**	**912**	Not relevant	**No**	2.60	2.00	11.00	0.47	Water channel	No	**Yes**
VIA_SP12_CGP+02	SP12	Viaduct	**0**	3495	**Relevant**	**No**	3.50	10.00	7.00	Not applicable	Water channel	No	**Yes**
UNP_SP12_SCG+02	SP12	Underpass	**0**	**0**	**Relevant**	**No**	2.20	5.00	8.00	**1.38**	Water channel	No	No
UNP_SP12_SCG+03	SP12	Underpass	**0**	**0**	Not relevant	**No**	3.00	7.00	5.00	**4.20**	Stream crossing	No	No
UNP_SP12_SCG+04	SP12	Underpass	**211**	**40**	Not relevant	yes	1.00	0.80	6.00	0.13	Water channel	No	No
UNP_SP12_SCG+05	SP12	Underpass	**0**	1966	Not relevant	yes	2.80	2.00	8.00	0.70	Water channel	No	No
UNP_SP12_SCG+06	SP12	Underpass	**0**	1220	Not relevant	**No**	1.50	1.00	6.00	0.25	Water channel	No	No
UNP_SP54_PSLCG+03	SP54	Underpass	**587**	**100**	**Relevant**	**No**	2.15	3.00	7.60	**0.85**	Unknown	No	No
UNP_SP54_PSLCG+04	SP54	Underpass					1.42	1.00	11.00	0.13	Pit	No	No
UNP_SP54_PSLCG+05	SP54	Underpass	**998**	**0**	**Relevant**	yes	6.30	6.80	7.60	**5.64**	Stream Crossing	No	No
UNP_SP54_PSLCG+06	SP54	Underpass	**591**	**765**	**Relevant**	yes	8.00	5.00	5.60	**1.75**	Stream Crossing	No	No
UNP_SP55_01	SP55	Underpass	**852**	**123**	Not relevant	**No**	2.80	3.00	7.50	0.47	Cattle trail	No	No
UNP_SP55_02	SP55	Underpass	**824**	**97**	Not relevant	**No**	1.20	1.50	8.00	0.11	Water channel	No	No
CUV_SP84_RA+01	SP84	Culvert/drainage	**763**	1074	**Relevant**	**No**	1.00	1.00	9.00	0.09	Water channel	No	No
UNP_SP84_RA+02	SP84	Underpass	**775**	1025	**Relevant**	**No**	1.82	2.00	7.80	0.47	Water channel	No	No
UNP_SP84_RA+03	SP84	Underpass	1089	**746**	**Relevant**	**No**	2.85	2.00	10.20	0.15	Water channel	No	No
UNP_SP84_RA+04	SP84	Underpass	1839	1452	**Relevant**	**No**	2.20	2.00	9.00	0.17	Water channel	No	No
UNP_SP84_RA+05	SP84	Underpass	1894	1725	**Relevant**	**No**	1.80	0.80	18.00	0.01	Water channel	No	No
UNP_SP84_RA+06	SP84	Underpass	1904	1713	**Relevant**	**No**	2.70	2.00	11.00	0.14	Water channel	No	No
UNP_SP84_RA+07	SP84	Underpass	1811	1694	**Relevant**	**No**	3.00	2.00	9.50	0.17	Stream crossing	No	No

Structure code	Road code	Type of crossing structure	Distance from suitable areas (m)	Distance from corridors (m)	Fine scale location	Human disturbance	Height (m)	Width (m)	Length	Openness index	Uses of the passages	Relevant to reduce AVC mortality	Bear presence highlight
UNP_SP84_RA+08	SP84	Underpass	1697	1600	**Relevant**	**No**	6.00	5.00	8.00	**3.75**	Stream crossing	No	No
UNP_SP84_RA+09	SP84	Underpass	1918	1886	**Relevant**	**No**	3.10	5.00	8.00	**1.94**	Stream crossing	No	No
OVP_SS17_113+200	SS17	Overpass	**756**	1922	**Relevant**	**No**	-	92.00	14.00	Not applicable	Unknown	**Yes**	**Yes**
OVP_SS17_116+400	SS17	Overpass	**219**	**981**	**Relevant**	**No**	-	49.00	13.00	Not applicable	Unknown	**Yes**	**Yes**
OVP_SS17_116+600	SS17	Overpass	**259**	**947**	**Relevant**	**No**	-	46.00	11.00	Not applicable	Unknown	**Yes**	**Yes**
OVP_SS17_117+700	SS17	Overpass	**342**	**472**	**Relevant**	**No**	-	217.00	15.00	Not applicable	Unknown	**Yes**	**Yes**
OVP_SS17_119+700	SS17	Overpass	**13**	**364**	**Relevant**	**No**	-	125.00	15.00	Not applicable	Unknown	**Yes**	**Yes**
OVP_SS17_120+000	SS17	Overpass	**0**	**125**	**Relevant**	**No**	-	225.00	15.00	Not applicable	Unknown	**Yes**	**Yes**
OVP_SS17_125+000	SS17	Overpass	**83**	1221	**Relevant**	**No**	-	830.00	15.00	Not applicable	Unknown	**Yes**	**Yes**
UNP_SS17_120+900	SS17	Underpass	**92**	**0**	**Relevant**	**No**	4.00	4.00	10.00	**1.60**	Forest road	**Yes**	**Yes**
UNP_SS17_121+600	SS17	Underpass	**0**	**48**	**Relevant**	**No**	4.70	3.50	32.00	0.51	Water channel	**Yes**	**Yes**
UNP_SS17_122+900	SS17	Underpass	**238**	1025	**Relevant**	**No**	4.20	4.00	4.00	**16.80**	Water channel	**Yes**	**Yes**
VIA_SS17_101+000	SS17	Viaduct	2580	2340	**Relevant**	Yes	N.R.	160.00	10	Not applicable	Stream Crossing	**Yes**	No
VIA_SS17_112+700	SS17	Viaduct	**856**	1954	**Relevant**	**No**	30.00	240.00	12.00	Not applicable	Unknown	**Yes**	**Yes**
VIA_SS17_116+300	SS17	Viaduct	**183**	**988**	**Relevant**	**No**	15.00	90.00	10.00	Not applicable	Water channel	**Yes**	**Yes**
VIA_SS17_116+500	SS17	Viaduct	**244**	**956**	**Relevant**	**No**	8.00	18.00	9.00	Not applicable	Water channel	**Yes**	**Yes**
VIA_SS17_116+700	SS17	Viaduct	**208**	1005	**Relevant**	**No**	25.00	110.00	10.00	Not applicable	Unknown	**Yes**	**Yes**
VIA_SS17_117+200	SS17	Viaduct	**0**	**608**	**Relevant**	**No**	20.00	166.00	10.00	Not applicable	Unknown	**Yes**	**Yes**
VIA_SS17_119+500	SS17	Viaduct	**79**	**545**	**Relevant**	**No**	30.00	240.00	10.00	Not applicable	Paved road	**Yes**	**Yes**
VIA_SS17_120+500	SS17	Viaduct	**141**	**0**	**Relevant**	**No**	25.00	65.00	9.00	Not applicable	Unknown	**Yes**	**Yes**
VIA_SS17_123+800	SS17	Viaduct	44	1544	**Relevant**	Yes	67.00	N.R.	N.R.	Not applicable	Paved road	Yes	Yes
CUV_SS487_10+550	SS487	Culvert/drainage	2828	1564	Not relevant	yes	1.50	1.50	10.00	0.18	Water drainage	No	No
CUV_SS487_17+400	SS487	Culvert/drainage	**708**	**163**	Not relevant	**No**	3.20	N.R.	20.00	N.R.	Stream Crossing	No	No
CUV_SS487_30+500	SS487	Culvert/drainage	**530**	**0**	Not relevant	**No**	1.00	1.10	7.00	0.14	Water channel	No	No
CUV_SS487_30+900	SS487	Culvert/drainage	**421**	**0**	Not relevant	**No**	0.80	0.80	7.00	0.07	Water channel	No	No
CUV_SS487_33+800	SS487	Culvert/drainage	**652**	**0**	Not relevant	**No**	0.80	0.80	10.00	0.05	Water channel	No	No
CUV_SS487_PSLCG+01	SS487	Culvert/drainage					0.80	0.70	6.00	0.06	Pit	No	No

Structure code	Road code	Type of crossing structure	Distance from suitable areas (m)	Distance from corridors (m)	Fine scale location	Human disturbance	Height (m)	Width (m)	Length	Openness index	Uses of the passages	Relevant to reduce AVC mortality	Bear presence highlight
UNP_SS487_14+100	SS487	Underpass	**801**	**239**	**Relevant**	yes	N.R.	3.00	9.00	NA	Stream Crossing	**Yes**	No
UNP_SS487_14+300	SS487	Underpass	**613**	**151**	**Relevant**	yes	2.20	2.90	9.00	0.71	Water drainage	**Yes**	No
UNP_SS487_16+600	SS487	Underpass	**643**	**0**	**Relevant**	**No**	1.65	2.80	14.00	0.33	Stream Crossing	**Yes**	No
UNP_SS487_17+200	SS487	Underpass	**798**	**142**	**Relevant**	**No**	1.50	1.50	13.00	0.14	Stream Crossing	**Yes**	No
UNP_SS487_26+050	SS487	Underpass	**374**	**312**	**Relevant**	yes	100.00	1.00	6.00	0.07	Water channel	No	No
UNP_SS487_26+100	SS487	Underpass	**407**	**339**	**Relevant**	yes	2.50	5.00	6.00	**2.08**	Stream Crossing	No	No
UNP_SS487_26+200	SS487	Underpass	**419**	**316**	Not relevant	**No**	1.14	1.10	6.00	0.08	Water channel	No	No
UNP_SS487_26+500	SS487	Underpass	**600**	**107**	Not relevant	**No**	1.20	1.45	6.00	0.29	Water channel	No	No
UNP_SS487_26+900	SS487	Underpass					1.26	1.50	6.00	0.32	Pit	No	No
UNP_SS487_27+250	SS487	Underpass	**600**	**0**	**Relevant**	**No**	4.00	1.40	6.00	0.13	Stream Crossing	No	No
UNP_SS487_27+550	SS487	Underpass					1.10	1.00	6.00	0.07	Pit	No	No
UNP_SS487_28+100	SS487	Underpass					1.00	1.00	6.00	0.13	Pit	No	No
UNP_SS487_28+200	SS487	Underpass					1.00	1.00	6.00	0.13	Pit	No	No
UNP_SS487_28+400	SS487	Underpass					1.30	0.90	6.00	0.05	Pit	No	No
UNP_SS487_28+750	SS487	Underpass	**947**	**0**	Not relevant	**No**	N.A.	1.30	6.00	0.22	Stream Crossing	No	No
UNP_SS487_28+850	SS487	Underpass	**939**	**0**	Not relevant	**No**	0.60	2.00	5.80	0.21	Stream Crossing	No	No
UNP_SS487_29+950	SS487	Underpass	**850**	**0**	Not relevant	**No**	3.50	0.94	7.00	0.05	Stream Crossing	No	No
UNP_SS487_30+000	SS487	Underpass	**852**	**0**	Not relevant	**No**	3.50	3.00	7.00	0.50	Stream Crossing	No	No
UNP_SS487_31+500	SS487	Underpass	**425**	**0**	Not relevant	**No**	2.00	2.00	6.50	0.24	Stream Crossing	No	No
UNP_SS487_32+600	SS487	Underpass	**374**	**0**	**Relevant**	**No**	10.00	10.00	6.00	**16.67**	Stream Crossing	No	No
UNP_SS487_32+900	SS487	Underpass	**453**	**0**	**Relevant**	**No**	4.00	5.00	6.00	**3.33**	Stream Crossing	No	No
UNP_SS487_6+700	SS487	Underpass	1283	2054	Not relevant	yes	4.00	10.00	8.00	**5.00**	Stream Crossing	No	No
UNP_SS487_PSLCG+02	SS487	Underpass	1133	**324**	**Relevant**	**No**	2.70	2.00	10.00	0.54	Water channel	No	No
UNP_SS487_SCG+01	SS487	Underpass	1845	1711	Not relevant	**No**	1.30	1.10	7.50	0.06	Water channel	No	No
VIA_SS487_10+400	SS487	Viaduct	2970	1722	Not relevant	yes	25.00	11.00	10.00	Not applicable	Viadotto	No	No
VIA_SS487_11+900	SS487	Viaduct	2393	1262	**Relevant**	yes	N.R.	4.00	9.00	Not applicable	Stream Crossing	**No**	No
VIA_SS487_12+500	SS487	Viaduct	2055	**975**	**Relevant**	**No**	N.R.	10.00	9.00	Not applicable	Stream Crossing	**Yes**	No

Structure code	Road code	Type of crossing structure	Distance from suitable areas (m)	Distance from corridors (m)	Fine scale location	Human disturbance	Height (m)	Width (m)	Length	Openness index	Uses of the passages	Relevant to reduce AVC mortality	Bear presence highlight
VIA_SS487_17+700	SS487	Viaduct	1642	**422**	**Relevant**	**No**	N.R.	9.00	8.00	Not applicable	Stream Crossing	No	No
UNP_SS84_CGP+05	SS84	Underpass	**548**	**55**	Not relevant	yes	1.55	1.50	9.50	0.24	Water channel	No	No
UNP_SS84_CGP+06	SS84	Underpass	1360	**576**	Not relevant	yes	1.50	2.20	9.50	0.35	Water channel	No	No
UNP_SS84_CGP+07	SS84	Underpass	1396	**503**	Not relevant	yes	1.80	1.20	8.00	0.27	Water channel	No	No
UNP_SS84_CGP+08	SS84	Underpass	1507	**506**	Not relevant	yes	1.80	1.20	8.00	0.28	Water channel	No	No
UNP_SS84_CGP+09	SS84	Underpass	1404	**498**	Not relevant	yes	2.00	3.00	8.50	0.39	Stream crossing	No	No
UNP_SS84_CGP+10	SS84	Underpass	1502	**769**	Not relevant	yes	0.80	2.00	9.00	0.32	Water channel	No	No
UNP_SS84_CGP+11	SS84	Underpass	1768	1453	Not relevant	yes	1.45	4.10	9.00	0.66	Water channel	No	No
UNP_SS84_CGP+12	SS84	Underpass	1814	1518	Not relevant	yes	2.00	4.50	8.50	**1.06**	Water channel	No	No
UNP_SS84_CGP+13	SS84	Underpass	1832	1545	Not relevant	yes	2.40	7.00	9.00	**1.87**	Stream crossing	No	No
UNP_SS84_CGP+14	SS84	Underpass	2176	1972	Not relevant	yes	1.20	1.60	9.50	0.20	Water channel	No	No

A segment between Pettorano S.G. and Rocca Pia, along the SS17, also resulted as a critical spot being interested by the presence of 3 AVC clusters, 2 of which are high sureness clusters, and 2 telemetry clusters (Figure 9). All the crossing structures falling in these two road segments have thus been considered as relevant in reducing AVC mortality and, if the others variables were accomplished as well, they have been classified as priority 1 structures.

One interesting result is that out of 23 structures classified as relevant in reducing AVC mortality, 20 also accomplished all the other criteria to be assigned to priority 1 meaning that 87% of the crossing structures present in high AVC-risky areas can be adapted to be used as wildlife crossing. In the same way out of 22 crossing structures located in road stretches where specific episodes concerning bears on the road happened, 18 resulted as priority 1 and 1 as priority 2. These results are an encouraging starting point to achieve objectives of Action C2.

Assessment of the actual current use by animals

Seven of the 35 crossing structures with priority 1 or 2 had evident presence sign (i.e. footprints) at the moment of the characterization field survey. Particularly, presence signs regarded mostly cervids (roe and red deer), wild boars and small mammals.

Table 5. List of crossing structures to be used as wildlife crossings with priority 1 and 2 and data on use by animals detected both during field surveys and with camera trap monitoring. Data collected in the Majella National Park Project area during the Life Safe-Crossing.

*** crossing structures monitored by the Monte Genzana Alto Gizio Nature Reserve personnel**

Structure code	Road code	Priority	Pressence signs	Accessible	Theft risk	Camera trap monitoring	Use detected with camera traps
VIA_SP12_CGP+02	SP12	2	**Yes**	**Yes**	**Low**	**Yes**	**Yes**
UNP_SP12_SCG+02	SP12	2	no	**Yes**	High	No	-
UNP_SP54_PSLCG+03	SP54	2	no	**Yes**	**Low**	**Yes**	**Yes**
UNP_SP84_RA+02	SP84	2	no	**Yes**	High	No	-
UNP_SP84_RA+03	SP84	2	no	**Yes**	High	No	-
UNP_SP84_RA+04	SP84	2	no	**Yes**	High	No	-
UNP_SP84_RA+06	SP84	2	no	**Yes**	High	No	-
UNP_SP84_RA+07	SP84	2	no	**Yes**	High	No	-
UNP_SP84_RA+08	SP84	2	no	**Yes**	High	No	-
UNP_SP84_RA+09	SP84	2	no	**Yes**	High	No	-
OVP_SS17_113+200	SS17	1	N.A.	**Yes**	**Low**	No	-

Structure code	Road code	Priority	Pressence signs	Accessible	Theft risk	Camera trap monitoring	Use detected with camera traps
OVP_SS17_116+400	SS17	1	**Yes**	**Yes**	**Low**	**Yes***	**Yes**
OVP_SS17_116+600	SS17	1	N.A.	**Yes**	**Low**	No	-
OVP_SS17_117+700	SS17	1	N.A.	**Yes**	**Low**	No	-
OVP_SS17_119+700	SS17	1	N.A.	**Yes**	**Low**	No	-
OVP_SS17_120+000	SS17	1	N.A.	**Yes**	**Low**	No	-
OVP_SS17_125+000	SS17	1	N.A.	**Yes**	**Low**	**Yes**	**Yes bears**
UNP_SS17_120+900	SS17	1	**Yes**	**Yes**	High	**Yes***	**Yes**
UNP_SS17_121+600	SS17	1	**Yes**	**Yes**	High	**Yes***	**Yes**
UNP_SS17_122+900	SS17	1	no	**Yes**	High	No	-
VIA_SS17_112+700	SS17	1	N.A.	**Yes**	High	No	-
VIA_SS17_116+300	SS17	1	**Yes**	**Yes**	High	No	-
VIA_SS17_116+500	SS17	1	N.A.	**Yes**	High	No	-
VIA_SS17_116+700	SS17	1	**Yes**	**Yes**	High	No	-
VIA_SS17_117+200	SS17	1	N.A.	**Yes**	High	No	-
VIA_SS17_119+500	SS17	1	N.A.	**Yes**	High	No	-
VIA_SS17_120+500	SS17	1	**Yes**	**Yes**	High	No	-
UNP_SS487_16+600	SS487	1	no	No		No	
UNP_SS487_17+200	SS487	1	no	No		No	
UNP_SS487_27+250	SS487	2	no	**Yes**	**Low**	**Yes**	**Yes**
UNP_SS487_32+600	SS487	2	no	**Yes**	High	No	-
UNP_SS487_32+900	SS487	2	no	**Yes**	**Low**	**Yes**	**Yes**
UNP_SS487_PSLCG+02	SS487	2	no	**Yes**	High	No	-
VIA_SS487_12+500	SS487	1	no	No		No	-
VIA_SS487_17+700	SS487	2	no	No		No	-

Four of the 35 crossing structures were not accessible and thus considered un-used. Eight of the remaining 31 crossing structures have been monitored with camera tarps, 4 having priority 1 and 4 having priority 2. In all the 8 crossing structures use by animals has been detected and, particularly, use by bears has been detected on one overpass of the SS17 (Tables 5-6). Three crossing structures have been monitored by the Monte Genzana Alto Gizio Nature Reserve and specific data on their use have not been gathered so far. Beyond the camera traps positioned along the priority 1 and 2 structures, 2 additional camera traps have been positioned in two priority 3/excluded structures (Table 6). However, both of them had to be removed prematurely because of high theft risk due to the presence of persons using the underpasses while one camera trap has actually been stolen just 15 days after its deployment (Table 6).

Table 6. Summary table reporting data on crossing structures camera trap monitoring implemented so far in the Majella National Park in the frame of the Life Safe-crossing.

*** stolen**

****removed prematurely because of high theft risk**

UNDERPASS CODE	DATE OF INSTALLATION	CAMERA SETTING	DATE OF REMOVAL	N.OF WORKING DAYS	N VIDEOS/PHOTO	SPECIES
OVP_SS17_125+000	17/06/2020	VIDEO	Still working	105	25	**BEAR**, wild boar, roe deer
UNP_SP12_CGP+04**	07/11/2019	VIDEO	04/12/2019	27	0	-
UNP_SP54_PSLCG+03*	19/11/2019	VIDEO	04/12/2019	15	13	Hare, fox, mouse
UNP_SP54_PSLCG+05**	08/11/2019	VIDEO	13/02/2020	97	0	-
UNP_SS487_27+250	05/11/2019	VIDEO	Still working	330	3	Wild cat, skunk
UNP_SS487_32+900	25/07/2019	PHOTO	06/07/2020	347	26	martens, wild cat, wild boar, skunk, fox, weasel
VIA_FOR_CGP+02	07/11/2019	VIDEO	13/02/2020	98	7	Roe deer, fox, hare
	30/09/2020	VIDEO	Still working	1	N.A.	-

The two camera traps removed prematurely did not register any video while all the other ones registered mainly video with small mammals (43 videos, 58%) but also large mammals like wild boars (3 videos, 4%) and roe deer (10 videos, 14%) were filmed. The most important result has actually been obtained on one overpass along the SS17 where two bear passages have been recorded by camera traps and 2 additional passages have been recorded only with presence signs detection (due to camera traps failure). Genetic samples belonging to the individuals filmed have been collected so that the identity of the bears can be known too.

Even though data collected so far are too poor to be analysed, a rough quantification of the distribution of videos during the day has been made. Results show that the majority of the videos has been registered from 18:01 to 00:00 (n. 29, 39%) and from 00:01 to 06:00 (n. 24, 32%) summing up to 53 videos (72%) (Figure 10).

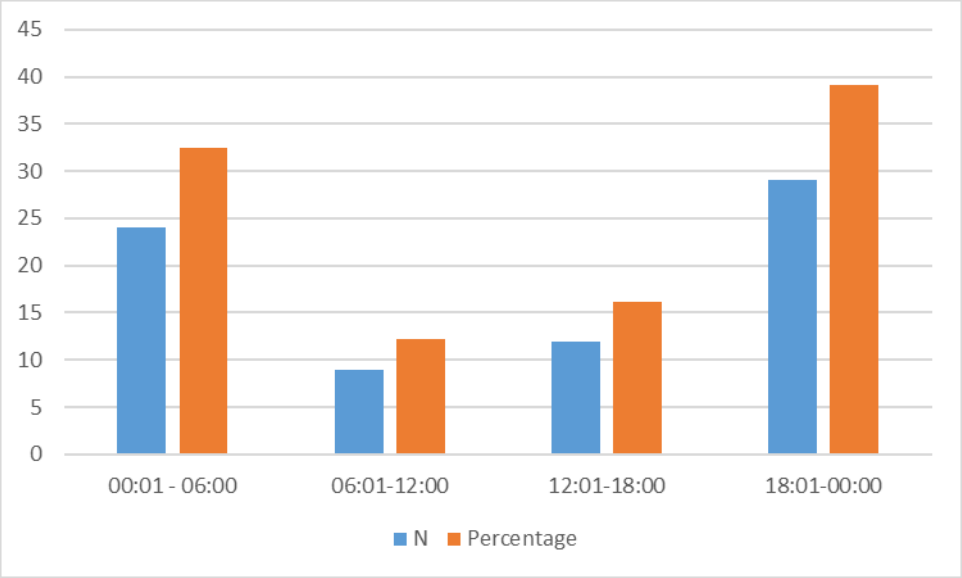


Figure 10. Rough distribution of videos during the day according to data collected with the crossing structures monitoring implemented in the Majella National Park study area in the frame of Action A4 of the life Safe-Crossing.

Individuation of interventions needed

Structures object of intervention in the frame of Action C2 are the ones falling in the Priority 1 and Priority 2 categories assigned basing on location and structure characteristics (see previous paragraphs). A total of 20 structures have priority 1 (7 overpasses, 5 underpasses, 8 viaducts) and a total of 15 structures have priority 2 (13 underpasses, 2 viaducts). The comparison of the actual structure characteristics with the ideal ones and the analysis of the possible low-cost interventions to implement led to the individuation of the following interventions needed: 5 obstacle mitigation, 5 possible re-vegetation, 17 inside cleaning, 18 fence installation (Table 7, Figure 11). Road potentially interested by C2 interventions are thus the SS17, SS487, SP12, SP54 and SP84 (Figure 11).

Table 7. Interventions needed for the crossing structures object of Action C2 (priority 1 and priority 2) in the Majella National Park Project area of the Life Safe-Crossing.

Intervention	Overpasses (n priority 1)	Underpasses (n priority 1)	Viaducts (n priority 1)	Total (n priority 1)
Substratum and water presence	0	0	0	**0**
Obstacles	1 (1)	4 (1)	0	**5 (2)**
Re-vegetation	2 (2)	1 (1)	2 (2)	**5 (3)**
Inside cleaning	-	15 (2)	2 (1)	**17 (3)**
Fencing	6 (6)	5 (5)	7 (7)	**18 (18)**

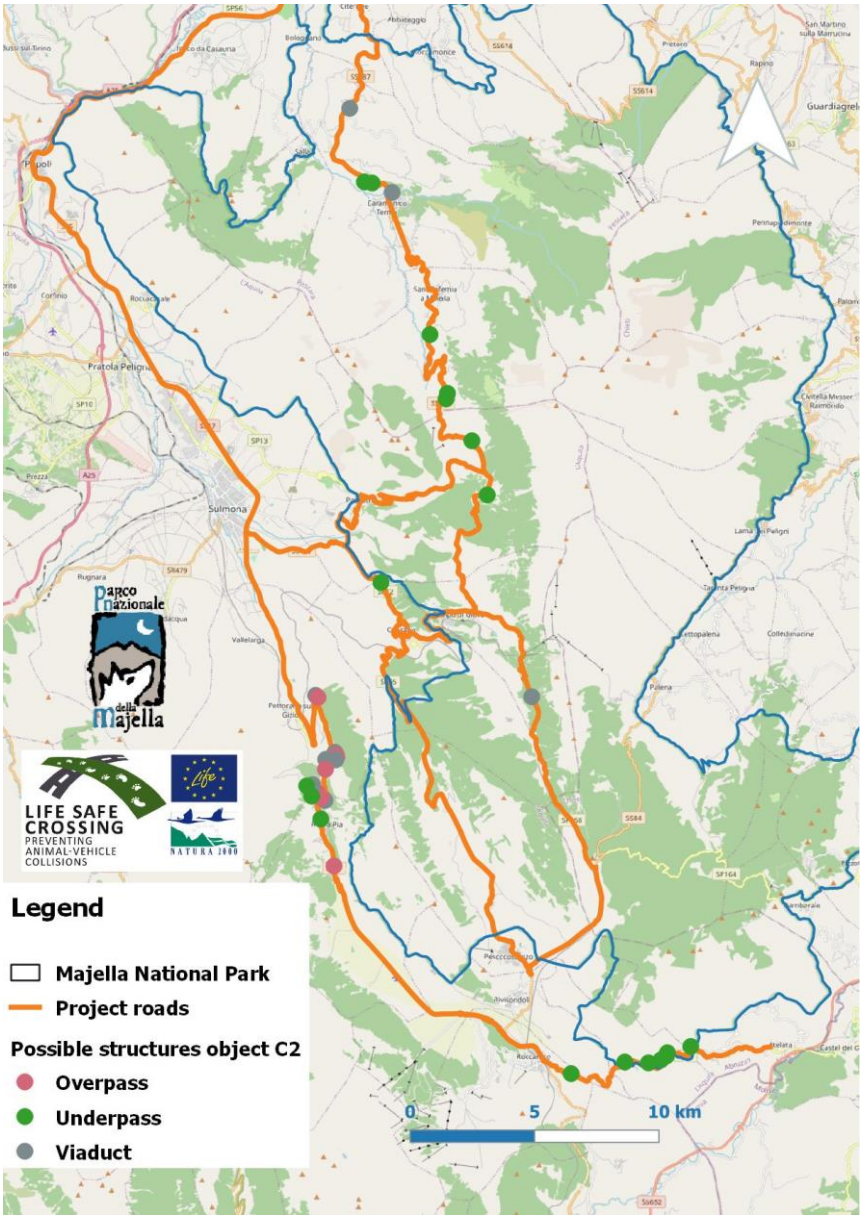


Figure 11. Location and type of the crossing structures selected in the frame of action A4 to be object of interventions foreseen in Action C2 in the Majella National Park Project area of the Life Safe-Crossing.

The evaluation of re-vegetation needed is based so far only on data entered in the database prepared in the frame of Action A4. The actual need of this intervention will thus be evaluated during the specific field surveys developed in the frame of Action C2 to prepare the final intervention plan. Results obtained with Action A4 are consistent with the Project proposal (where 12 fences were foreseen along the SS17 and 3 underpasses cleaning was foreseen along the SS487) and suggest the need to implement additional measures. The final intervention plan will thus take into account these additional needs and an analysis of A4 results in light of economic resources foreseen in the budget will be carried out in order to implement most interventions possible.
A detailed table reporting variables evaluated for each crossing structure is reported in **Annex I**.

Final considerations

The Action A4 was implemented in the PNM according to the Project and no major issues need to be reported. Results obtained with A4 are thus:

- a complete database with data concerning all the crossing structures present in the Project roads.
- prioritization of crossing structures to be adapted as wildlife crossings based on habitat suitability, presence of corridors, bear presence, fine scale location and dimension.
- Individuation of crossing structures to be object of Action C2 and individuation of the interventions needed on each structure.
- a catalogue of the crossing structures reporting the main variables and the specific pictures.
- quantification of structures use with wildlife presence signs and camera traps.

This last issue is, perhaps, the only one where some difficulties have been encountered mainly because of the high thefts risk in the PNM. Given the importance of monitoring the impact of interventions on wildlife crossing use, during Action D1 the camera trap monitoring will be strengthened applying specific measures to reduce thefts.

Results obtained with Action A4 allowed the individuation of the crossing structures with highest probability of being used by bears and the assessment of interventions needed. In the frame of Action C2 a final intervention plan, drafted after the implementation of field surveys aimed at assessing every intervention-related detail, will be produced where economic resources available in the Project budget will also be analysed in order to maximize the achievement of C2 objectives. Data collected in the frame of Action A4 refer to a number of crossing structures larger than the one to be handled with the Project economic resources and this is an important result as it guarantees data availability for the implementation of after-Life activities and any other possible additional road ecology project to be implemented in the future. Considering that PNM Project roads have been selected as the ones highly important for Apennine brown bear conservation, priority 3 structures excluded by intervention in the frame of Action C2 could still be adapted to be used by bears. Activities implemented during the after-Life period will thus take into account this possibility with the scope to build, during the years, a more and more suitable environment for bears.

Annex I – DETAILED TABLES

Data on location, type, dimension and use of the 87 crossing structures characterized in the Majella National Park Project area in the frame of Action A4 of the Life Safe-Crossing.

Code	Road code	X UTM WGS84	Y UTM WGS84	Type	Section	Height (m)	Diameter (m)	Width (m)	Length (m)	Openness index	Use
UNP_SP12_CGP+1	SP12	423082	4649168	Underpass	Vault	2.2	Not applicable	1.60	8	0.13	Water channel
UNP_SP12_CGP+3	SP12	423513	4646736	Underpass	Vault	3.5	Not applicable	4.00	7.6	0.83	Water channel
UNP_SP12_CGP+4	SP12	424439	4643668	Underpass	Rectangular	2.6	Not applicable	2.00	11	0.47	Water channel
UNP_SP12_SCG+2	SP12	417355	4652628	Underpass	Rectangular	2.2	Not applicable	5.00	8	1.38	Water channel
UNP_SP12_SCG+3	SP12	418105	4651073	Underpass	Rectangular	3	Not applicable	7.00	5	4.20	Stream crossing
UNP_SP12_SCG+4	SP12	417964	4650445	Underpass	Rectangular	1	Not applicable	0.80	6	0.13	Water channel
UNP_SP12_SCG+5	SP12	420144	4650308	Underpass	Rectangular	2.8	Not applicable	2.00	8	0.70	Water channel
UNP_SP12_SCG+6	SP12	419545	4651262	Underpass	Rectangular	1.5	Not applicable	1.00	6	0.25	Water channel
VIA_SP12_CGP+2	SP12	423411	4648032	Viaduct	Vault	3.5	Not applicable	10.00	7	Not applicable	Water channel
UNP_SP54_PSLCG+3	SP54	421625	4656150	Underpass	Semi-circular	2.15	Not applicable	3.00	7.6	0.85	Unknown
UNP_SP54_PSLCG+4	SP54	421460	4656158	Underpass	Circular/Vault	1.42	Not applicable	1.00	11	0.13	Unknown
UNP_SP54_PSLCG+5	SP54	421223	4655538	Underpass	Rectangular	6.3	Not applicable	6.80	7.6	5.64	Stream Crossing
UNP_SP54_PSLCG+6	SP54	420680	4652729	Underpass	Vault	8	Not applicable	5.00	5.6	1.75	Stream Crossing
UNP_SP55_01	SP55	419274	4644279	Underpass	Vault	2.8	Not applicable	3.00	7.5	0.47	Cattle trail
UNP_SP55_02	SP55	419315	4644920	Underpass	Vault	1.2	Not applicable	1.50	8	0.11	Water channel
CUV_SP84_RA+1	SP84	424928	4632930	Culvert	Circular	1	1.00	1.00	9	0.09	Water channel
UNP_SP84_RA+2	SP84	424997	4632879	Underpass	Rectangular	1.82	Not applicable	2.00	7.8	0.47	Water channel
UNP_SP84_RA+3	SP84	427154	4633346	Underpass	Vault	2.85	Not applicable	2.00	10.2	0.15	Water channel

Code	Road code	X UTM WGS84	Y UTM WGS84	Type	Section	Height (m)	Diameter (m)	Width (m)	Length (m)	Openness index	Use
UNP_SP84_RA+4	SP84	428106	4633311	Underpass	Vault	2.2	Not applicable	2.00	9	0.17	Water channel
UNP_SP84_RA+5	SP84	428613	4633421	Underpass	Vault	1.8	Not applicable	0.80	18	0.01	Water channel
UNP_SP84_RA+6	SP84	428612	4633434	Underpass	Vault	2.7	Not applicable	2.00	11	0.14	Water channel
UNP_SP84_RA+7	SP84	428828	4633590	Underpass	Vault	3	Not applicable	2.00	9.5	0.17	Stream crossing
UNP_SP84_RA+8	SP84	428867	4633718	Underpass	Rectangular	6	Not applicable	5.00	8	3.75	Stream crossing
UNP_SP84_RA+9	SP84	429805	4633970	Underpass	Rectangular	3.1	Not applicable	5.00	8	1.94	Stream crossing
OVP_SS17_113+200	SS17	414823	4648005	Overpass	Circular	-	Not applicable	92.00	14	Not applicable	Unknown
OVP_SS17_116+400	SS17	415544	4645724	Overpass	Circular	-	Not applicable	49.00	13	Not applicable	Unknown
OVP_SS17_116+600	SS17	415580	4645610	Overpass	Circular	-	Not applicable	46.00	11	Not applicable	Unknown
OVP_SS17_117+700	SS17	415121	4645114	Overpass	Circular	-	Not applicable	217.00	15	Not applicable	Unknown
OVP_SS17_119+700	SS17	414950	4643969	Overpass	Circular	-	Not applicable	125.00	15	Not applicable	Unknown
OVP_SS17_120+000	SS17	414811	4644165	Overpass	Circular	-	Not applicable	225.00	15	Not applicable	Unknown
OVP_SS17_125+000	SS17	415466	4641229	Overpass	Circular	-	Not applicable	830.00	15	Not applicable	Unknown
UNP_SS17_120+900	SS17	414369	4644448	Underpass	Rectangular	4	Not applicable	4.00	10	1.60	Forest road
UNP_SS17_121+600	SS17	414570	4644038	Underpass	Rectangular	4.7	Not applicable	3.50	32	0.51	Water channel
UNP_SS17_122+900	SS17	414938	4643118	Underpass	Rectangular	4.2	Not applicable	4.00	4	16.80	Water channel
VIA_SS17_101+000	SS17	412059	4655023	Viaduct	Rectangular	N.R.	Not applicable	160.00	10	Not applicable	Stream Crossing
VIA_SS17_112+700	SS17	414729	4648089	Viaduct	Rectangular	30	Not applicable	240.00	12	Not applicable	Unknown
VIA_SS17_116+300	SS17	415503	4645799	Viaduct	Rectangular	15	Not applicable	90.00	10	Not applicable	Water channel

Code	Road code	X UTM WGS84	Y UTM WGS84	Type	Section	Height (m)	Diameter (m)	Width (m)	Length (m)	Openness index	Use
VIA_SS17_116+500	SS17	415569	4645667	Viaduct	Rectangular	8	Not applicable	18.00	9	Not applicable	Water channel
VIA_SS17_116+700	SS17	415533	4645495	Viaduct	Rectangular	25	Not applicable	110.00	10	Not applicable	Unknown
VIA_SS17_117+200	SS17	415133	4645514	Viaduct	Rectangular	20	Not applicable	166.00	10	Not applicable	Unknown
VIA_SS17_119+500	SS17	415104	4643864	Viaduct	Rectangular	30	Not applicable	240.00	10	Not applicable	Paved road
VIA_SS17_120+500	SS17	414609	4644497	Viaduct	Rectangular	25	Not applicable	65.00	9	Not applicable	Unknown
VIA_SS17_123+800	SS17	415067	4642372	Viaduct	Rectangular	67	Not applicable	N.R.	10	Not applicable	Paved road
CUV_SS487_10+550	SS487	416579	4673252	Culvert	Circular	1.5	Not applicable	1.50	10	0.18	Water drainage
CUV_SS487_17+400	SS487	415511	4670072	Culvert	Rectangular	3.2	Not applicable	N.R.	20	N.R.	Stream Crossing
CUV_SS487_30+500	SS487	419803	4661545	Culvert	Circular	1	Not applicable	1.10	7	0.14	Water channel
CUV_SS487_30+900	SS487	419909	4661519	Culvert	Circular	0.8	Not applicable	0.80	7	0.07	Water channel
CUV_SS487_33+800	SS487	419705	4659598	Culvert	Circular	0.8	Not applicable	0.80	10	0.05	Water channel
CUV_SS487_PSLCG+1	SS487	420050	4658509	Culvert	Circular	0.8	0.70	0.70	6	0.06	Water channel
UNP_SS487_14+100	SS487	415534	4670177	Underpass	Rectangular	N.R.	Not applicable	3.00	9	0.00	Stream Crossing
UNP_SS487_14+300	SS487	415440	4670007	Underpass	Rectangular	2.2	Not applicable	2.90	9	0.71	Water drainage
UNP_SS487_16+600	SS487	416688	4668734	Underpass	Circular/Rectangular	1.65	Not applicable	2.80	14	0.33	Stream Crossing
UNP_SS487_17+200	SS487	417000	4668689	Underpass	Circular	1.5	1.50	1.50	13	0.14	Stream Crossing
UNP_SS487_26+050	SS487	419590	4663491	Underpass	Vault	100	Not applicable	1.00	6	0.07	Water channel
UNP_SS487_26+100	SS487	419599	4663455	Underpass	Semi-circular	2.5	Not applicable	5.00	6	2.08	Stream Crossing
UNP_SS487_26+200	SS487	419485	4663369	Underpass	Vault	1.14	Not applicable	1.10	6	0.08	Water channel

Code	Road code	X UTM WGS84	Y UTM WGS84	Type	Section	Height (m)	Diameter (m)	Width (m)	Length (m)	Openness index	Use
UNP_SS487_26+500	SS487	419453	4663135	Underpass	Semi-circular	1.2	Not applicable	1.45	6	0.29	Water channel
UNP_SS487_26+900	SS487	419313	4662856	Underpass	Circular/Vault	1.26	Not applicable	1.50	6	0.32	Water channel
UNP_SS487_27+250	SS487	419325	4662597	Underpass	Vault	4	Not applicable	1.40	6	0.13	Stream Crossing
UNP_SS487_27+550	SS487	419285	4662432	Underpass	Vault	1.1	Not applicable	1.00	6	0.07	Water channel
UNP_SS487_28+100	SS487	419435	4661929	Underpass	Circular	1	1.00	1.00	6	0.13	Water channel
UNP_SS487_28+200	SS487	419421	4661892	Underpass	Circular	1	1.00	1.00	6	0.13	Water channel
UNP_SS487_28+400	SS487	419312	4661728	Underpass	Vault	1.3	Not applicable	0.90	6	0.05	Water channel
UNP_SS487_28+750	SS487	419304	4661402	Underpass	Circular	N.A.	1.30	1.30	6	0.22	Stream Crossing
UNP_SS487_28+850	SS487	419296	4661404	Underpass	Semi-circular	0.6	Not applicable	2.00	5.8	0.21	Stream Crossing
UNP_SS487_29+950	SS487	419414	4661110	Underpass	Vault	3.5	Not applicable	0.94	7	0.05	Stream Crossing
UNP_SS487_30+000	SS487	419457	4661224	Underpass	Vault	3.5	Not applicable	3.00	7	0.50	Stream Crossing
UNP_SS487_31+500	SS487	419891	4661119	Underpass	Vault	2	Not applicable	2.00	6.5	0.24	Stream Crossing
UNP_SS487_32+600	SS487	420026	4660232	Underpass	Semi-circular	10	Not applicable	10.00	6	16.67	Stream Crossing
UNP_SS487_32+900	SS487	419972	4660010	Underpass	Semi-circular	4	Not applicable	5.00	6	3.33	Stream Crossing
UNP_SS487_6+700	SS487	416536	4675776	Underpass	Rectangular	4	Not applicable	10.00	8	5.00	Stream Crossing
UNP_SS487_PSLCG+2	SS487	421009	4658326	Underpass	Rectangular/Vault	2.7	Not applicable	2.00	10	0.54	Water channel
UNP_SS487_SCG+1	SS487	415461	4654210	Underpass	Vault	1.3	Not applicable	1.10	7.5	0.06	Water channel
VIA_SS487_10+400	SS487	416482	4673395	Viaduct	Rectangular	25	Not applicable	11.00	10	Not applicable	Viadotto
VIA_SS487_11+900	SS487	416387	4672045	Viaduct	Rectangular	N.R.	Not applicable	4.00	9	Not applicable	Stream Crossing

Code	Road code	X UTM WGS84	Y UTM WGS84	Type	Section	Height (m)	Diameter (m)	Width (m)	Length (m)	Openness index	Use
VIA_SS487_12+500	SS487	416099	4671694	Viaduct	Rectangular	N.R.	Not applicable	10.00	9	Not applicable	Stream Crossing
VIA_SS487_17+700	SS487	417803	4668312	Viaduct	Rectangular	N.R.	Not applicable	9.00	8	Not applicable	Stream Crossing
UNP_SS84_CGP+5	SS84	425978	4640828	Underpass	Rectangular	1.55	Not applicable	1.50	9.5	0.24	Water channel
UNP_SS84_CGP+6	SS84	426182	4639966	Underpass	Rectangular	1.5	Not applicable	2.20	9.5	0.35	Water channel
UNP_SS84_CGP+7	SS84	426159	4639643	Underpass	Rectangular	1.8	Not applicable	1.20	8	0.27	Water channel
UNP_SS84_CGP+8	SS84	426119	4639282	Underpass	Rectangular	1.8	Not applicable	1.20	8	0.28	Water channel
UNP_SS84_CGP+9	SS84	426001	4638916	Underpass	Vault	2	Not applicable	3.00	8.5	0.39	Stream crossing
UNP_SS84_CGP+10	SS84	425659	4638714	Underpass	Rectangular	0.8	Not applicable	2.00	9	0.32	Water channel
UNP_SS84_CGP+11	SS84	424972	4638183	Underpass	Rectangular	1.45	Not applicable	4.10	9	0.66	Water channel
UNP_SS84_CGP+12	SS84	424908	4638139	Underpass	Rectangular	2	Not applicable	4.50	8.5	1.06	Water channel
UNP_SS84_CGP+13	SS84	424881	4638116	Underpass	Rectangular	2.4	Not applicable	7.00	9	1.87	Stream crossing
UNP_SS84_CGP+14	SS84	424473	4637878	Underpass	Rectangular	1.2	Not applicable	1.60	9.5	0.20	Water channel

Specific table elaborated to evaluate possible intervention needed for each of the 35 priority 1 and priority 2 crossing structures out of the 87 characterized in the Majella National Park Project area in the frame of Action A4 of the Life Safe-Crossing. Characteristics requiring interventions are reported in bold. E = entrance.

Structure code	Road code	Type of crossing structure	Priority	Substratum material	Presence of water	Type of obstacle E1	Type of obstacle E2	Vegetation coverage E1 (%)	Vegetation coverage E2 (%)	Inside cleaning needed	Fence installation needed
OVP_SS17_113+200	SS17	Overpass	1	Natural substratum	No	-	-	50-75	**5-24**	-	No
OVP_SS17_116+400	SS17	Overpass	1	Natural substratum	No	-	-	50-75	50-75	-	**yes**
OVP_SS17_116+600	SS17	Overpass	1	Natural substratum	No	-	**Wall**	75-100	75-100	-	**yes**
OVP_SS17_117+700	SS17	Overpass	1	Natural substratum	No	-	-	75-100	75-100	-	**yes**
OVP_SS17_119+700	SS17	Overpass	1	Natural substratum	No	-	-	50-75	**25-49**	-	**yes**
OVP_SS17_120+000	SS17	Overpass	1	Natural substratum	No	-	-	75-100	75-100	-	**yes**
OVP_SS17_125+000	SS17	Overpass	1	Natural substratum	No	-	-	50-75	50-75	-	**yes**
UNP_SS17_120+900	SS17	Underpass	1	Concrete	No	-	-	**25-49**	**25-49**	No	**yes**
UNP_SS17_121+600	SS17	Underpass	1	Concrete	No	-	-	75-100	75-100	No	**yes**
UNP_SS17_122+900	SS17	Underpass	1	Concrete	No	-	-	75-100	75-100	No	**yes**
UNP_SS487_16+600	SS487	Underpass	1	Natural substratum	Yes, temporal	Stone or concrete ramp (20°)	Earth	75-100	75-100	**Yes**	**yes**
UNP_SS487_17+200	SS487	Underpass	1	Concrete	Yes, temporal	-	**Stone or concrete ramp (90°)**	75-100	75-100	**Yes**	**yes**
VIA_SS17_112+700	SS17	Viaduct	1	Natural substratum	No	-	-	**25-49**	**25-49**	No	No
VIA_SS17_116+300	SS17	Viaduct	1	Natural substratum	No	-	-	**5-24**	**5-24**	No	**yes**
VIA_SS17_116+500	SS17	Viaduct	1	Natural substratum	No	-	-	75-100	75-100	No	**yes**
VIA_SS17_116+700	SS17	Viaduct	1	Natural substratum	No	-	-	75-100	75-100	No	**yes**
VIA_SS17_117+200	SS17	Viaduct	1	Natural substratum	No	-	-	75-100	75-100	No	**yes**
VIA_SS17_119+500	SS17	Viaduct	1	Natural substratum	No	-	-	50-75	50-75	No	**yes**
VIA_SS17_120+500	SS17	Viaduct	1	Natural substratum	No	-	-	50-75	50-75	No	**yes**
VIA_SS487_12+500	SS487	Viaduct	1	Natural substratum	Yes, temporal	-	-	75-100	75-100	**Yes**	**yes**

Structure code	Road code	Type of crossing structure	Priority	Substratum material	Presence of water	Type of obstacle E1	Type of obstacle E2	Vegetation coverage E1 (%)	Vegetation coverage E2 (%)	Inside cleaning needed	Fence installation needed
UNP_SP54_PSLCG+03	SP54	Underpass	2	Concrete	No	-	-	75-100	75-100	**Yes**	to be evaluated
UNP_SP84_RA+02	SP84	Underpass	2	Natural substratum	Yes, permanent	-	-	75-100	75-100	**Yes**	to be evaluated
UNP_SP84_RA+03	SP84	Underpass	2	Natural substratum	Yes, permanent	-	-	75-100	75-100	**Yes**	to be evaluated
UNP_SP84_RA+04	SP84	Underpass	2	Natural substratum	Yes, temporal	-	-	75-100	75-100	**Yes**	to be evaluated
UNP_SP84_RA+06	SP84	Underpass	2	Natural substratum	Yes, temporal	**Stone or concrete ramp (90°)**	-	75-100	75-100	**Yes**	to be evaluated
UNP_SP84_RA+07	SP84	Underpass	2	Natural substratum	Yes, temporal	**Stone or concrete ramp (90°)**	-	75-100	75-100	**Yes**	to be evaluated
UNP_SP84_RA+08	SP84	Underpass	2	Natural substratum	Yes, temporal	-	-	75-100	75-100	**Yes**	to be evaluated
UNP_SP84_RA+09	SP84	Underpass	2	Natural substratum	Yes, permanent	-	-	75-100	75-100	**Yes**	to be evaluated
UNP_SS487_27+250	SS487	Underpass	2	Natural substratum	Yes, temporal	-	Riprap	75-100	75-100	**Yes**	to be evaluated
UNP_SS487_32+600	SS487	Underpass	2	Natural substratum	Yes, permanent	-	**Concrete ramp (90°)**	75-100	75-100	**Yes**	to be evaluated
UNP_SS487_32+900	SS487	Underpass	2	Natural substratum	Yes, permanent	-	-	75-100	75-100	**Yes**	to be evaluated
UNP_SS487_PSLCG+02	SS487	Underpass	2	Concrete	Yes, permanent	-	-	75-100	75-100	**Yes**	to be evaluated
UNP_SP12_SCG+02	SP12	Underpass	2	Natural substratum	No	-	-	75-100	75-100	**Yes**	to be evaluated
VIA_SP12_CGP+02	SP12	Viaduct	2	Natural substratum	No	-	-	75-100	75-100	No	to be evaluated
VIA_SS487_17+700	SS487	Viaduct	2	Natural substratum	Yes, permanent	-	-	75-100	75-100	**Yes**	to be evaluated