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A Review of terrestrial vegetation, habitat and fauna research in the “Laghi di Conversano” (IT9120006) Ecological Network Area (2024)

Conversano (Bari), November 2024

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Project title: Awareness raising, training, and scientific research activities on species and Habitat of Community interest

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1. INTRODUCTION

The site is characterized geologically by dolineform depressions with a clay bottom which favour the stagnation of water, captured with artificial artefacts of historical interest. The Conversano Lakes represent a safe shelter for the life forms present, some of high value and rarity. The vegetative activity is maximum in the spring and autumnal seasons. The submerged hydrophytic phytocenosis of *Chara* spp. and *Nitella* spp. (green algae), today are very rare, while the semi-submerged vegetation of *Paspalum paspaloides*, an American allochthonous species (D'Amico S., Signorile G., 2003) is more widespread. *Carex divisa* meadows are very localized as *Eryngium pusillum* and *Allium atroviolaceum* listed in the regional red lists, while *Teucrium campanulatum* became extinct about 15 years ago. In the uncultivated areas of Castiglione locality, we find schrub and wood plants typical of Mediterranean vegetation such as *Quercus trojana*, *Olea europaea, Phillyrea latifolia, Rhamnus alaternus, Pistacia lentiscus* and many wild edible species such as *Aspragaus acutifolius, Leopoldia comosa, Borago officinalis,* and *Chicorium intybus*.

As far as amphibians regards, the reserve is characterized by the presence of the Italian newt (*Lissotriton italicus*), a central-southern endemic species, and of the Italian green toad (*Bufotes balearicus*), which in the spring period migrates to and from the water for reproductive, nutritional and exploratory reasons by the newly youngest. These two species and *Zerynthia polyxena*, a very colourful butterfly that can be spotted near lakes, are mentioned in Annex IV of the Habitats Directive 92/43 EEC. Among the reptiles there are Western whip snake *Hierophis viridiflavus*, Somooth snake *Coronella austrica*, Leopard snake *Zamenis situla*, (defined as the most beautiful European snake) and Four-lined snake *Elaphe quatuorlineata;* the latter two species are included in Annex II.
There are also Kotschy's gecko *Mediodactylus kotschyi*, Western green lizard *Lacerta bilineata* and Italian wall lizard *Podarcis siculus*.

Over 150 species of birds populate the Site. We mention, for example, Common kestrel *Falco tinnunculus*, Eurasian sparrowhawk *Accipiter nisus*, Eurasian buzzard *Buteo buteo*, as well as nocturnal birds such as Northern long-eared owl *Asio otus*, Small owl *Athene noctua* and Common barn-owl *Tyto alba*. There are also migrant bird species linked to the ponds such as Little egret *Egretta garzetta,* Great white egret *Ardea alba*, Wood Sandpiper *Tringa glareola*, Little Crake *Zapornia parva,* Black-winged stilt *Himantopus himantopus* and many other species.

The Conversano lakes was identified for priority habitat 3170* "Mediterranean temporary ponds", which is an ephemeral habitat characterized by small-sized plant species. This habitat can be subject to ecological and anthropic pressures that can quickly modify it in the Mediterranean climate contexts.

The last update of the Standard Data Form of this Natura 2000 site is dated December 2023 (https://download.mase.gov.it/Natura2000/Trasmissione%20CE_dicembre2023/schede_mappe/Puglia/ZSC_schede/Site_IT9120006.pdf) following that of May 2019. In the latest update (2023), the habitats of the temporary ponds 3170*, the annual meadows 6220*, the rocky habitat 8310 and the evergreen woods with *Quercus ilex* 9340 are no longer reported, while are reported only two habitats: 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (65.4 hectares), and the new habitat 9250 *Quercus trojana* woods (152.6 hectares). This work has allowed us to verify if the exclusion of some habitats is correct, in particular for 6220* and 3170*, both priority habitats. Specific attention was paid to the habitat that allowed the establishment of this Natura 2000 site: 3170* "Mediterranean temporary

ponds". This is an intrinsically sensitive habitat because it is characterized by small dimensions and the presence of ephemeral and small-sized species, subject to several ecological and anthropic pressures and threats as: total habitat collapses by mechanical means, changes in land use and intensification of agricultural activities, specifically the ending of extensive agropastoral activities, drainage, nutrient input, physical impact on sediments, new invasive alien and ruderal species. *Eryngium pusillum* L. is one of the species of greatest conservation interest for habitat 3170* present in the site and for which monitoring and conservation actions are planned.

Photo 1 Natura 2000. Temporary ponds with Paspalum paspaloides at Castiglione.

Table 1. Species and habitats of directive 92/43 EEC reported in NATURA 2000 Site (date: 2023)

Area code	Area name	Habitat type	Natura code
IT9120006	Laghi di Conversano	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	3140
		Quercus trojana woods	9250

The Regional Oriented Nature Reserve "Lakes of Conversano and Gravina di Monsignore" (347 hectares) established on 13 June 2006, includes the Natura 2000 site "Laghi di Conversano" (218 hectares), with

the only addition of the Gravina di Mansignore. The ancient relationship between human and the territory play an ecological key role in the 10 ponds, improperly called lakes: "Lago di Sassano", "Lago di Agnano", "Lago di Castiglione", "Lago di Chienna", "Lago di Iavorra", "Lago di Minuzzi", "Lago di Padula", "Lago di Petrullo", "Lago di S. Vito", "Lago di Vignola", "Gravina di Monsignore".

2. METHODOLOGY

The field exploration and activities in the study area aimed to preserving the terrestrial habitats, flora and fauna of conservation interest of the Natura 2000 site (site code: IT9120006 Laghi di Conversano) and in two areas outside of the site: 1) Gravina di Monsignore, that is ecological linked with Laghi di Conversano and was added at ten lake of Natura 2000 site “Laghi di Conversano” in the Regional Oriented Nature Reserve "Lakes of Conversano and Gravina di Monsignore"; 2) Bosco Monteferraro, the best natural area geographically close with Natura 2000 site. The exploration activities were carried out by the botanist and zoologist with administrative support of the Public Institution of Municipality of Conversano and includes the following field activities:

Transects

- Botanist and zoologist will work together on 4 transects, each of 1 km (figures 2, 3, 4 and 5), appropriately drawn up in order to combine the two skills of botany and zoology.

Botanist

The vegetation surveys were conducted by the phytosociological method of the Zurich–Montpellier school (1932) (the species coverage values as shown in the table 1), with identification code, scientific taxon name, locality, date, geographic position (WGS84 - World Geodetic System 1984), and topographical data [(Identification code, altitude (m.a.s.), aspect (°), slope (°), relevé area (m^2), code habitat of directive 92/43 EEC] and photo.

For the identification of taxa, Flora Europaea (Tutin et al. 1968-1980) and Flora d’Italia (2017-2019) were used; for nomenclature Bartolucci et al. (2018) and Galasso et al. (2018) were followed and for syntaxonomic nomenclature Mucina et al. (2016) was consulted. Were also adopted about habitat identification the Interpretation Manual of European Union Habitats (European Commission DG Environment 2007) and the “Manuale d’interpretazione degli Habitat comunitari in Italia” (2010) (http://vnr.unipg.it/habitat/), and finally the technical reports of habitat observed (i.e. for 6220* habitat https://policycommons.net/artifacts/209061/management-of-natura-2000-habitats-pseudo-steppe-with-grasses-and-annuals-thero-brachypodietea-6220/777560/

- have been performed 18 phytosociological surveys for 4 Transects with a useful buffer of 50 m to carry out the phytosociological survey;
- it was necessary to carry out 27 phytosociological surveys to detect the habitats 92/43 EEC and vegetation observed in each of the 10 lakes;
- during the vegetation surveys, species of conservation interest were also verified with specific assessments in terms of ecology, pressures and threats, especially for *Eryngium pusillum, Allium atroviolaceum, Damasonium alisma, Teucrium campanulatum* and other species

Photo 2 – Conversano Lakes (Study area). The lakes in green lines

Photo 3 and 4. Castiglione transects (the two red lines on the left) and *Gravina di Monsignore* (yellow line on the right)

Photo 5. Bosco Monteferraro (yellow line on the left)

Photo 6 and 7. Eryngium pusillum (on the left) and *Teucrium campanulatum* (on the right) extinct in the area.

In addition to field exploration, other activities are performed as organisation of educational workshops and professional lectures on a regular basis.

Table 1 – Plant species cover assessed based on the following abundance scores (Braun-Blanquet 1932)

Value	Coverage
r	rare
+	species with coverage of less than 1%
1	species that covers from 1 to 5% of the relief surface
2	species that covers from 5 to 25% of the relief surface
3	species that covers from 25% to 50% of the relief surface
4	species that covers from 50 to 75% of the relief surface
5	species that covers from 75 to 100% of the relief surface

Zoologist

The zoologist carried out checks on 4 the transects on the animal species of conservation interest, and the populations status for all lakes of Conversano, following the concept work of the botanist. The methodology adopted for the following four species:

Lissotriton italicus (Italian newt)

- *Population size estimate*. For the "population estimate" parameter the species was studied using the following method: repeated counts (at least three times);
- *Estimation of habitat quality for the species*. The main parameters to define the quality of the habitat in relation to the Italian newt are: presence of natural vegetation belts natural or green infrastructure (GI) surroundings of the breeding site, absence of alien predatory species (specifically ichthyofauna), absence of spills, absence of works (or traces thereof) of maintenance and management of the site or the vegetation;
- *Field actions*. The presence of the species can be detected all year in the case of permanent aquatic sites, but preferably in the spring months for both adults and larvae in the case of seasonal aquatic sites (e.g. pools). For the demographic data collection we consider a minimum of three samplings for site. To confirm reproduction, the search for larvae was carried out between the end of February and June in relation of the hydroperiod of breeding site. In biotopes with good visibility is possible to consider the option with visual search (even with the aid of binoculars). The Italian newt is also active during the day, therefore daytime visits were carried out to facilitate inspections;
- *Working days for year*. Three samplings for site.

Bufotes balearicus (Italian green toad)

- *Population size estimate*. To obtain a numerical estimate of the population, repeated counts of individuals in reproductive activity (and singing males) were carried out at individual sites during twilight or night;
- *Estimation of habitat quality for the species*. The main parameters to define the quality of the habitat of green toads are the presence of competing or predatory exotic species (e.g. fish, Trachemys scripta), the presence of polluting sources, the duration of the hydroperiod in temporary sites, the presence of roads with high vehicular traffic near breeding sites.

- *Field actions*. Green toads are easily contactable, especially at night, during the breeding season, during which the males emit their very characteristic and easily audible nocturnal songs. For each sampling site, a transect of approximately 500 m length was identified. All transects were catalogued and mapped, to allow standardized repetitions over the years. The following were always be noted on the sheets: the start and end time of the sampling, the number of singing males and the number of individuals observed, the sex and age (young or adult), not only of the species under investigation, but also of other amphibians present. The breeding season for *B. balearicus* is usually between March and early May. The species is active especially after sunset, on nights with mild temperatures preceded by rainy nights, preferably after dry periods. Successful reproduction has been confirmed by the discovery of eggs, larvae or newly metamorphosed individuals.
- *Working days for year*. Three sessions were carried out per site during the year, during the period of maximum activity of the specie.

Elaphe quatuorlineata (Four-lined snake)

- *Population size estimate*. The population parameter was estimated through standardized counts in sample sites, in order to obtain abundance indices;
- *Estimation of habitat quality for the species*. The main parameters to define the quality of the habitat are the presence of agricultural mosaics with scrub and garrigue, agricultural areas and rocky outcrops or dry stone walls. The cause of decline for the species is the destruction of dry-stone walls, hedges and woods, the removal of stone and environmental modifications, especially in the agricultural environment. Therefore, these phenomena are to be considered indicators of deterioration in the quality of habitats. Simultaneously with monitoring, the pressures and potential threats to the conservation of the species were detected.
- *Field actions*. Four transects of 1 km length have been identified in the area, to be replicated six times during the monitoring year. All the selected transects were recorded and mapped, to allow standardized repetitions over the years. The following are always noted on the sheets: the start and end time of sampling, the number of individuals observed, the sex and age (young or adult), not only of the species under investigation, but also of other reptiles observed. The months of greatest activity are April, May and June. The surveys were conducted through opportunistic visual research, in pre-established suitable habitats, such as scrubland and broad-leaved woods and agricultural areas with the presence of dry-stone walls. Given the ecology of the species, monitoring activities were carried out during daytime, in the months of maximum activity, avoiding cold, rainy and strong wind days. Any overnight resting sites (tree cavities, rocks, ruins, etc.) were also inspected. Valid information for the periodic confirmation of the presence of the species in the 10x10 km cells also derives from the search for specimens killed by impacts with cars;
- *Working days for year*. To obtain numerical indices, six repetitions of the transects were carried out.

Zamenis situla (Leopard snake)

- *Population size estimate***.** For this parameter, abundance indices obtained through repeated counts in an adequate number of sample points were estimated.

- *Estimation of habitat quality for the species*. The main parameters to define the quality of the habitat are the presence of agricultural mosaics with broad-leaved forests, agricultural areas and rocky outcrops or dry stone walls. The cause of decline for the species is the destruction of dry-stone walls, hedges and woods, stone removal and environmental alterations, especially in agricultural environments.
- *Field actions***.** The surveys were conducted through opportunistic visual research, in suitable pre-established habitats, such as broad-leaved woods and agricultural areas with the presence of dry-stone walls, also inspecting possible refuge sites (tree cavities, stone heaps, ruins, etc.). For each location, 4 transects of 1 km each were identified. All the selected transects were recorded and mapped, to allow standardized repetitions over the years. The following were noted on the sheets: the start and end time of sampling, the number of individuals observed, the sex and age (young or adult), not only of the species being investigated, but also of other reptiles present.. Valid information for the periodic confirmation of the presence of the species in the 10x10 km cells also derives from the collection of data relating to specimens killed by impacts with cars.
- *Working days for year***.** To obtain numerical indices, six repetitions of the transects were carried out.

During the surveys conducted for the snakes listed in Annex II, information was also collected on other reptile species included in the Directive, specifically: *Hierophis viridiflavus* (Western whip snake), *Coronella austriaca* (Smooth snake), *Lacerta bilineata* (Western green lizard), *Podarcis siculus* (Italian wall lizard), and *Mediodactylus kotschyi* (Kotschy's gecko).

3. RESULTS

3.1. Mapping of the Terrestrial vegetation, Habitats and Species Identified within the Laghi di Conversano (Special Areas of Conservation - IT9120006)

The data were collected through field research carried out in the 2024 year, inside the Territorial Plan of the protected area "Regional Natural Reserve “Laghi di Conversano e Gravina di Monsignore”. The field observations unconfirmed the presence of habitats 3140, 3170*, while the habitats 6220* and 9340 were sampled. In addition, must be added habitat 91AA*. Regarding plant species of conservation interest were not identified many typical taxa reported in the past, as *Teucrium campanulatum* and *Eryngium pusillum*, strictly linked to habitat 3170*, confirming the previous botanist observations (Tab. 2).
Unfortunately, the negative trend for the “Laghi di Conversano” Natura 2000 site is confirmed, which has seen a reduction in habitats in the last two Natura 2000 Standard Data Forms (dated 2019 and 2023). In 2019, 6 habitats of Directive 92/43 EEC were reported, while in 2023 only 2. Table 2 shows the updates between the two Standard Data Forms and the present situation.

Paspalum paspaloides, an invasive plant species, inside the lakes is the main pressure and threat in the Natura 2000 site, whose high invasion is due to human pressure, bad management, and the decreasing of annual rainfull.

During the research activities have been observed many human activities (dumping of harmful waste, fires and plowing) that caused damage to the “wetland” vegetation and the disappearance of *Teucrium campanulatum* and other species of conservation interest typical of habitat 3170*. Specifically, in one of the better-preserved lakes (Agnano Lake), plowing with a tractor was observed in the late springer season with partial breakage of wall-stone of one of the reservoirs of this lake.

Photo 8. Lago di Agnano before plowing. 30 Mach 2024

Photo 9. Lago di Agnano after plowing. 11 May 2024

Photo 10. Lago di Agnano. Dry rebuilding well. 11 May 2024

Considering the state of the area investigated, is suggested to monitor the reserve area, raising awareness among the stakeholders.

Overall, 15 field inspections were carried out to observe the plant species of interest and survey the wild vegetation. The vegetation surveys were carried out in 6 days and covered 10 lakes and 4 transects as follows: 18 surveys along the four transects and 27 surveys for the 10 lakes (Appendix 1).

Table 2 - Habitat differences between the 2019, 2023 Standard Data Form and 2024

Habitat	Habitat Code	SDF 2019	SDF 2023	2024 (this work)
Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	3140	reported	reported	**extinct**
Mediterranean temporary ponds	3170*	reported	not reported	**extinct**
Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*	6220*	reported	not reported	confirmed
Caves not open to the public	8310	reported	not reported	?
Quercus ilex and *Quercus rotundifolia* forests	9340	reported	not reported	confirmed
Quercus trojana woods	9520	not reported	9520	confirmed
Eastern white oak woods	91AA*	not reported	not reported	**new**

3.2. Phytosociological samples (Special Areas of Conservation- IT9120006)

The phytosociological surveys (appendix 1) were carried out from March to May 2024 and distributed as follows:

Place	Samples number	date	identified Habitat
Transect 1	6	16/3/2024	91AA*
Transect 2	2	16/3/2024	9340
Transect 3	5	23/3/2024	9340
Transect 4	5	23/3/2024	6220*, 9250
Castiglione	2	16/3/2024	-
Agnano	3	8/4/2024	-
Chienna	4	8/4/2024	-
Petrullo	3	1/5/2024	-
Padula	2	1/5/2024	-
Iavorra	3	10/5/2024	6220*

San Vito	3	10/5/2024	-
Lago di Minuzzi	2	11/5/2024	-
Lago di Vignola	3	11/5/2024	-
Lago di Sassano	2	11/5/2024	-
Total	**45**		

3.2.1 Vegetation transects

3.2.1.1 Oak woods

Surveys 1, 2 and 15 (rel. 1, 2 of transect 2 and rel. 15 of transect 3. See photos and appendix 1) identify the ***Quercus ilex* and *Quercus rotundifolia* forests (habitat code 9340)**, thanks to the high coverage of *Q. ilex*, the physiognomy species that also has a good coverage as a shrub level at Castiglione (Rel. 1 and 2) suggesting a good habitat regeneration. At Castiglione we also observed some species typical of the vegetation of *Quercetea ilicis*, such as *Pistacia lentiscus* and *Rubia peregrina*. The floristic composition is very poor due to the human frequentation. Gravina di Monsignore is in better condition due to less harmful human presence and grow many typical species of this vegetation as *Ruscus aculetaus*, *Rhamnus alaternus* and *Cyclamen hederifolium* (rel. 15).
At Castiglione, in the southernmost sector of the transect 1, in a good natural environment (rel. from 3 to 7 of transect 1. See photos and appendix 1) a *Q. pubescens* deciduous woods have been identified. The corresponding priority habitat is **Eastern white oak woods (habitat code 91AA*)**, new for this Natura 2000 site. In these woods, as for the holm oak, was observed a good regeneration of shrub layer, especially for the presence of *Phyllyrea latifolia* and *Pistacia lentiscus*, while *Olea europaea* suggests the presence of nearby olive crops.
Another type of oak forest is the mesoxerophilous to thermophilous neutral-subacidophilous forests, pure or mixed with *Quercus trojana* (rel. 13 of transect 4. See photo and appendix 1). Its presence is significant as it is a relict connected to the wide woods of the Murgia materana and Murgia laertina and in the south-eastern of Murge. The environmental status of the site is moderate good, considering the high coverage of the shrub layer with *Crataegus monogyna*, *Pistacia lentiscus, Rhamnus alaternus* and *Asparagus acutifolius*, with also *Cyclamen hederifolium.* This vegetation is included in ***Quercus trojana* woods (habitat code 9250).**

3.2.1.2 Garrigues and shrub vegetation

Surveys 1 and 2 (rel. 8 of transect 1 and rel. 12 of transect 4. See photos and appendix 1). The vegetation of *Cistus monspeliensis* and *Cytisus infestus* are unaffected to summer drought and have a fair amount of resilience in fire contexts, which in this specific our case involved in many types of vegetation, including shrubland and woods. The fire resistance is due to the ability of the seeds to withstand high temperatures, especially for the species of the genus *Cistus* (called pyrophytic species). The surveys show poor species, highlighting the presence of taxa of *Querceta ilicis* class. These garrigues derive dynamically from the degradation of the *Q. pubescens* oak forests and are favoured by the frequent arson, that occur in this sector of the study area.
The evergreen sclerophyllous scrub (rel. 10 and 11 of transect 4. See photos and appendix 1), are physiognomically characterized by *Pistacia lentiscus*. The floristic composition includes many sclerophyllous scrubs of *Oleo-Ceratonion siliquae* alliance and of higher order, such as *Achnatherum bromoides, Olea europaea*, *Rhamnus alaternus, Cyclamen hederifolium* and *Rubia peregrina*. These

community frequently take contact with all vegetation observed in the plots. Further phenomena of degradation caused by fire lead after the *Cistus monspeliensis* plant community to *Pistacia lentiscus* vegetation, even if the sclerophyllous scrub sometimes derives from the degradation of the existing woods.

3.2.1.3 Annual and perennial herbaceous vegetation

In the study area some perennial aspects related to the habitat **Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea (habitat code 6220*)** were found (rel. 9 of transect 4. See photos and appendix 1). The sampling shows that it is a poor aspect of a typical xerophilous grasslands that in our case is dominated by *Dactylis glomerata* ssp. *hispanica* and *Charybdis pancration,* but with a potential to evolve in richer grasslands in the absence of disturbance or controlled disturbance (such as managed sheep grazing).

At Gravina di Monsignore annual vegetation with *Melissa officinalis* has been identified (rel. 17 of transect 3. See photos and appendix 1). These is anthropogenic communities that group the ruderal and nitrophilous pioneer communities often made up of large thistles and other annual, biennial or perennial plants with late winter or summer flowering. The survey shows that *Melissa officinalis* is associated with a few other species, including *Stachys major*.

Nitrophilous community dominated by *Smyrnium olusatrum* (rel. 18 of transect 3. See photos and appendix 1), consisting of perennial herbaceous species. The suballiance *Smyrnienion olusatri* includes communities of nitrophilous and sciaphilous megaforbs that form mesophilous edges near woods, like our case, and walls. *Smyrnium olusatrum* is associated with high coverage by *Parietaria officinalis*

3.2.2 Lake vegetation

Within the 10 Conversano Lakes, field surveys have highlighted the absence of woodland vegetation and wetland plant communities such as temporary Mediterranean ponds (habitat code 3170*) because the typical species of this habitat were not found: *Eryngium pusillum*, *Teucrium campanulatum* and *Damasonium alisma*. Many nitrophilous plant communities have replaced the typical plant communities reported in the past.

3.2.2.1 Shrub vegetation

Rubus ulmifolius is the most widespread scrub community located at the edges of the reservoirs of Conversano lakes (Castiglione, Chienna, Petrullo, San Vito, Lago di Minuzzi, Lago di Vignola) (rel. 13, 16, 19, 27, 30, 36, 39, 42. See photos and appendix 1). This vegetation is generally found on many types of soils with varying degrees of water retention, which contain different amounts of organic matter. These edaphic characteristics allow the growth of different species depending on the water conditions present in the substrates. Therefore, these communities represent ecological gradients that depending on the water factor, as also observed in our case study.

3.2.2.2 Annual and perennial herbaceous vegetation

Therophytic aspect related to the habitat **Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea (habitat code 6220*)** were found at Iavorra (rel. 33. See photos and appendix 1). In the same lake where *Teucrium campanulatum* was reported in the past, it has been observed in a very limited surface and near the road, the annual meadows of *Stipion retortae* alliance, that occurs under thermo-Mediterranean and semiarid climates, due to the presence of *Stipellula capensis*.

The other herbaceous vegetation are nitrophilous or subnitrophilous, as *Convolvulo arvensis-Agropyrion repentis* syntaxon, an alliance that groups ruderal-nitrophilous communities made up of perennial grasses

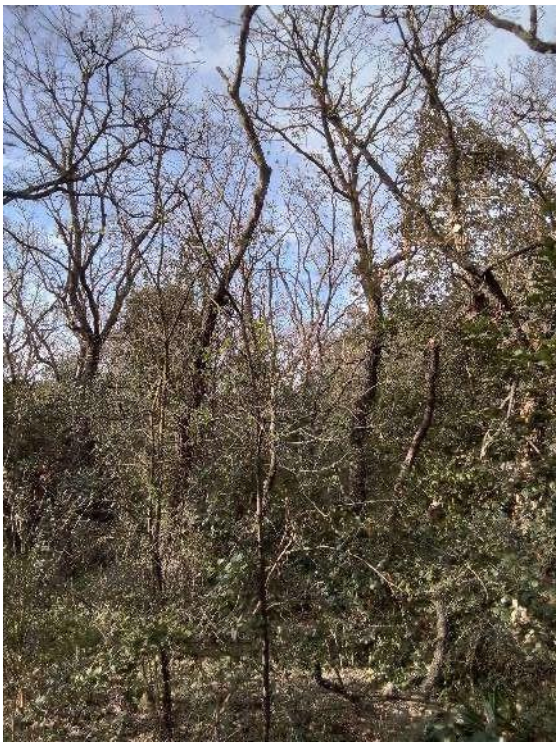
dominated by *Elymus repens*. In the study area this vegetation has been observed in the lakes of Agnano, Iavorra, Lago Minuzzi and Lago Vignola (rel. 23, 35, 40, 41. See photos and appendix 1).
Only at Chienna (rel. 24 and 26. See photos and appendix 1) was detected the vegetation consisting of medium-height grasses plant resistant to desiccation, dominated by *Bolboschoenus maritimus*. The communities referred to *Scirpenion maritimi* subaliance that are potentially distributed throughout the Italian territory.
The *Paspalum paspaloides* vegetation reported for Petrullo, Padula and San Vito (rel. 29, 31 and 38. See photos and appendix 1) refers to Mediterranean sub-halo-nitrophilous communities related to substrates subjected to a long period of submersion, dominated by large, creeping species and refer to *Isoëto-Nanojuncetea* class. This plant community has replaced over time due for many reasons, including the reduced water supply, the plant communities of temporary ponds (habitat 3170*). It's worth to note that *Paspalum paspaloides* is an alien species that should be deleted in favour of native species. For this reason, it is recommended a translocation actions of plant species historically reported in the "Lakes of Conversano", coming from other sites in the same area such as *Damasonium alisma, Teucrium campanulatum*, *Eryngium pusillum* and *Verbena supina* typical of habitat 3170* reported in the past.
Other nitrophilous vegetation are those of *Avena sativa, Glebionis coronaria, Geranium dissectum, Anisantha madritensis, Galactites tomentosus* and other species with a wide distribution found in many Conversano lakes, and don't have any conservation value (rel. 26, 28, 29, 31, 32, 34, 38. See photos and appendix 1.
Finally, the *Cyperus* sp. pl. and *Potamogeton* sp. vegetations at Sassano (rel. 44 and 45. See photos and appendix 1) cannot be assessed because it represents an artificial action with water planting using non-native species in contradiction with all European guidelines and laws of Natura 2000 sites.


Rel.1. *Trans. 1*. *Q. ilex* wood. Habitat 9340


Rel.2. *Trans. 1*. *Q. ilex* wood. Habitat 9340

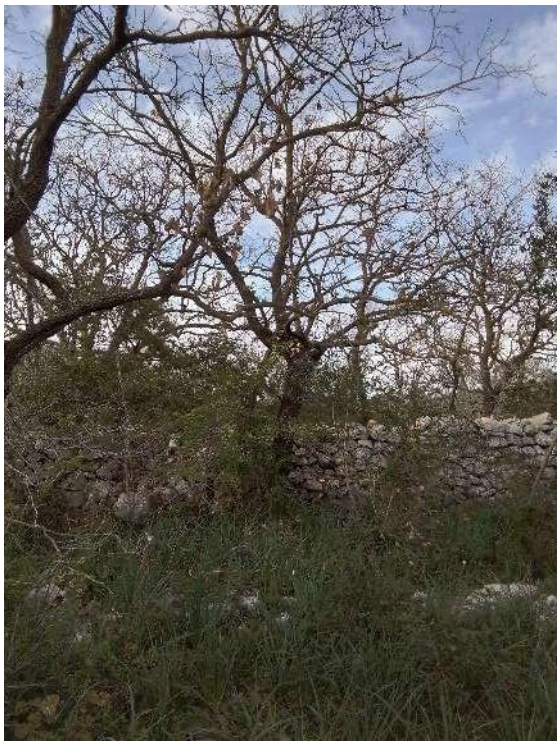
Rel. 3. *Trans. 1. Q. pubescens* wood. Hab.91AA*

Rel. 4. *Trans. 1. Q. pubescens* wood. Hab.91AA*



Rel. 5. *Trans. 1. Q. pubescens* wood. Hab.91AA

Rel. 6. *Trans. 1. Q. pubescens* wood. Hab.91AA*



Rel. 7. *Trans. 1*. *Q. pubescens* wood. Hab. 91AA*

Rel. 8. *Trans. 1*. *Cistus monspeliensis* garrigue

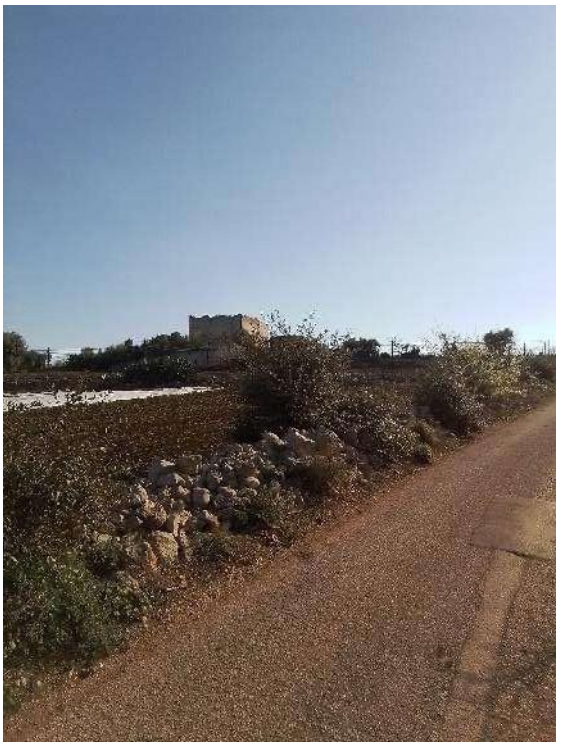
Rel. 9. *Trans. 2*. Perennial meadow. Hab. 6220*

Rel. 10. *Trans. 2*. Evergreen scrubland

Rel. 11. *Trans. 2*. Evergreen scrubland

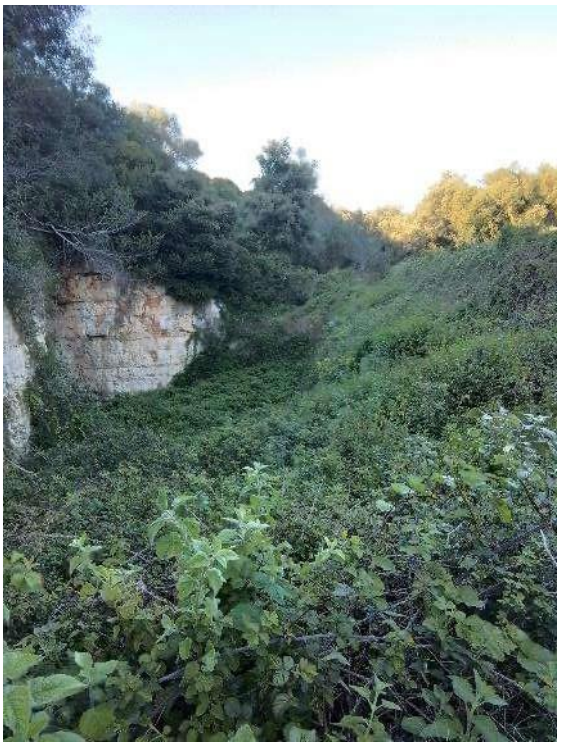
Rel. 12. *Trans. 2*. *Cistus monspeliensis* garrigue

Rel. 13. *Trans. 2*. *Q. trojana* wood. Habitat 9250

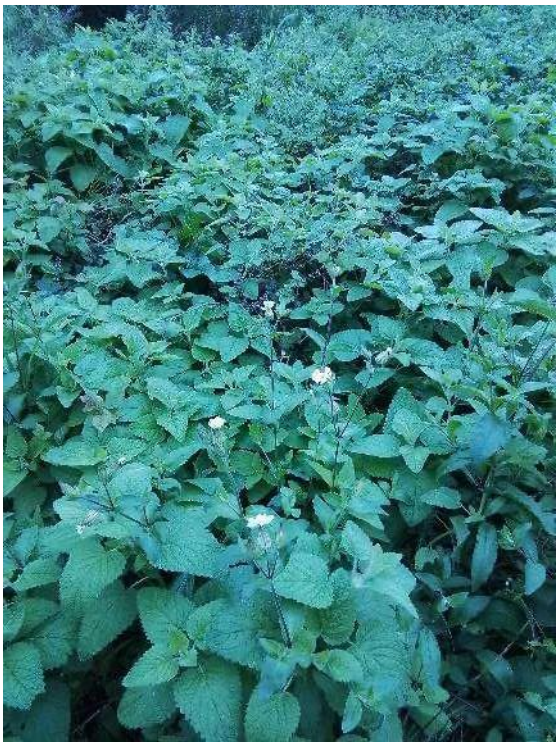


Rel. 14. *Trans. 2*. Green infrastructure

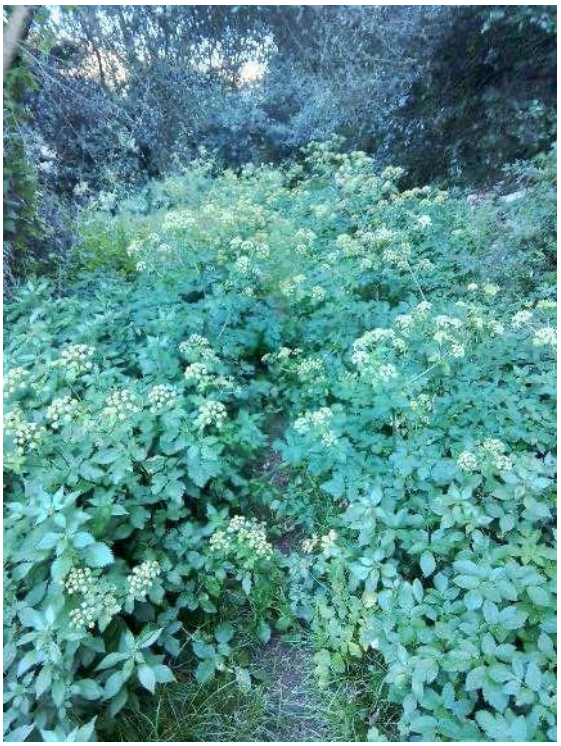
Rel. 15. *Trans. 2*. *Q. ilex* wood. Habitat 9340



Rel. 16. *Trans. 2*. Brumble scrubland



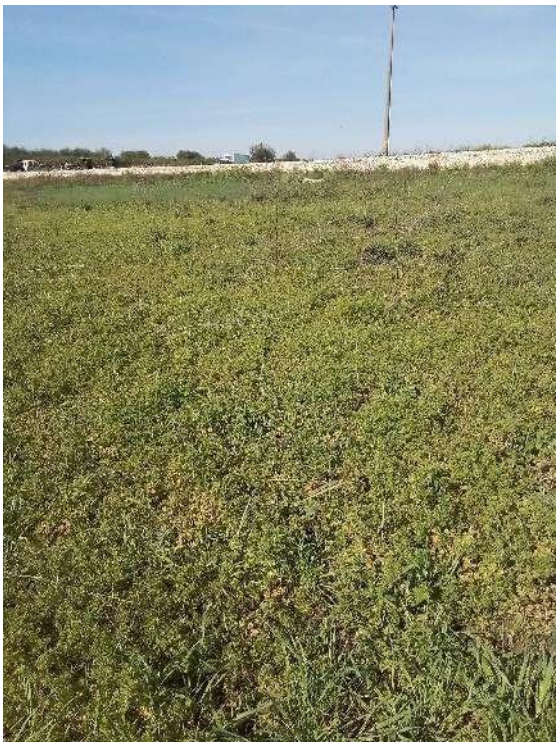
Rel. 17. *Trans. 2*. *Melissa officinalis* community.



Rel. 18. *Trans. 2*. *S.olusatrum* & *P. officinalis* comm.

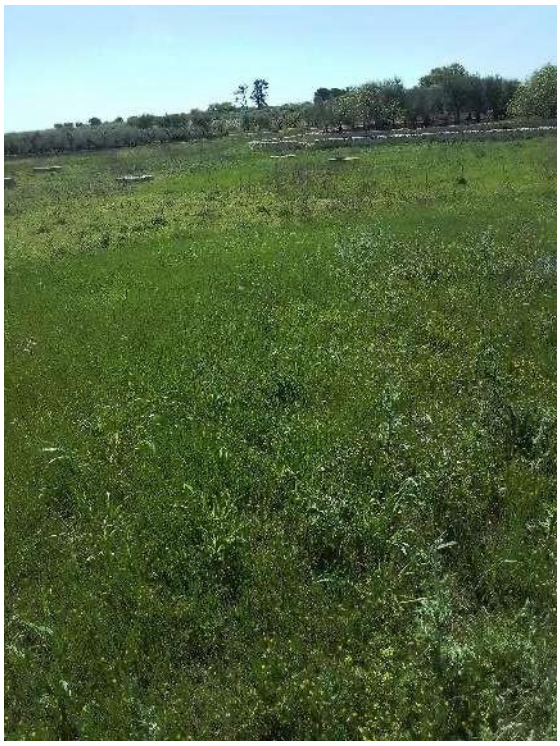
Rel. 19. Castiglione. *Rubus ulmifolius* scrubland

Rel. 20. Castiglione. *Paspalum paspaloides* comm.



Rel. 21. Agnano. *Geranium dissectum* community

Rel. 22. Agnano. *Galium verum* community



Rel. 23. Agnano. *Elymus repens* community

Rel. 24. Chienna. *Bolboschoenus maritimus* comm.

Rel. 25. Chienna. *Geranium dissectum* community

Rel. 26. Chienna. *Anisantha madritensis* comm.

Rel. 27. Chienna. *Rubus ulmifolius* community

Rel. 28. Petrullo. *Anisantha madritensis* comm.

Rel. 29. Petrullo. *Paspalum paspaloides* community

Rel. 30. Petrullo. *Rubus ulmifolius* comm.

Rel. 31. Padula. *Paspalum paspaloides* community

Rel. 32. Padula. *Glebionis coronaria* community

Rel. 33. Iavorra. *Stipion capensis* community

Rel. 34. Iavorra. *Galactites tomentosus* community

Rel. 35. Iavorra. *Rostraria cristata* community

Rel. 36. San Vito. *Rubus ulmifolius* community

Rel. 37. San Vito. *Bituminaria bituminosa* community

Rel. 38. San Vito. *Rumex crispus* community

Rel. 39. Lago di Minuzzi. *Rubus ulmifolius* comm.

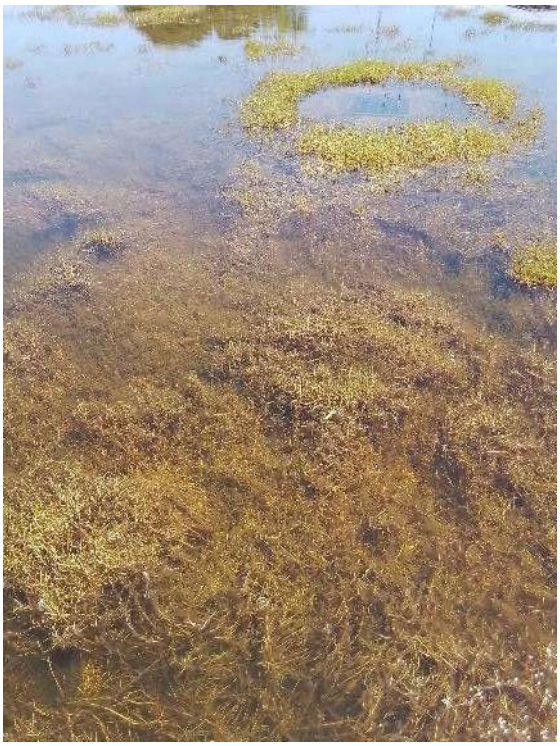
Rel. 40. Lago di Minuzzi. *Elymus repens* community

Rel. 41. Lago di Vignola. *Elymus repens* comm.

Rel. 42. Lago di Vignola. *Rubus ulmifolius* comm.

Rel. 43. Lago di Vignola. *Dasypyrum villosum* comm.

Rel. 44. Sassano. *Cyperus alternifolius* comm.



Rel. 45. Sassano. *Potamogeton* sp. comm.

3.3 Amphibians and Reptiles (Habitats Directive) present in the Special Area of Conservation IT9120006 Laghi di Conversano.

Monitoring of amphibians was conducted across all sinkholes within the SAC, covering different phenological phases of the two target species, the Italian newt and the Italian green toad. For reptiles, four representative areas of the territory were surveyed using the same transects as those employed in the botanical section. In the following sections, results are analyzed for each monitored species, and appropriate amendments to the Standard Data Form are suggested for the next update.

6918 *Bufotes balearicus* (Italian green toad)

Italian green toad (adult male)

Surveys for this species began in February and continued until May to cover the entire reproductive season. Although only one site (Sassano) exhibited an extended hydroperiod, the protocol was applied to other lakes as well, conducting active searches for individuals hidden in shelters or checking for road-killed specimens from the evenings prior to the survey. During the study period, the sinkholes were deemed unsuitable for supporting populations of this species, as water presence (with the exception of Sassano)

was observed only at San Vito, Padula, Castiglione, and Petrullo, and only for brief periods and limited surface areas.
The population observed at Sassano was the only one where reproductive success could be confirmed. Once abundant in the area, this species is now highly scarce, with 2024 data confirming this negative trend, though a slight recovery is evident only at the Sassano site, where it had nearly disappeared by 2022. No individuals were recorded near Castiglione, Chienna, or Iavorra, where hundreds of pairs were previously documented.
The estimated number of pairs for Sassano in 2024 (and therefore for the entire SAC) is a maximum of 40 pairs; however, the number of tadpoles/newly metamorphosed individuals was only in the low hundreds. Among the major pressures on the species, road traffic remains a significant issue (Liuzzi et al., 2011; Lorusso et al., 2008; Vlora et al., 2007), particularly near breeding sites. Indeed, on the perimeter roads around Lake Sassano, over 100 deceased individuals were counted just during the surveys. This mortality rate exerts a tangible impact on the already declining population, further jeopardizing its survival. The recent introduction of *Gambusia* into Sassano has likely had a substantial negative effect on reproductive success, as this invasive species has compounded the already significant presence of non-native goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), and non-native turtles, along with domestic ducks (albeit in much lower numbers than in the recent past).

Sito	Session 1 (28-29 February)	Session 2 (12 March)	Session 3 (15 April-23 May)
Sassano	15 ad.	40 pairs.	3 ad.; 250 girini
Chienna	0	0	0
Iavorra	0	0	0
Agnano	0	0	0
Castiglione	0	0	0
Vignola	0	0	0
Padula	0	0	0
San Vito	0	0	0
Petrullo	0	0	0
Minuzzi	0	0	0

Summary of the surveys conducted for the Italian green toad

Species					**Population in the site**			**Motivation**
Group	**CODE**	**Scientific Name**	**S**	**NP**	**Size**	**Unit**	**Cat.**	**Species Annex**
A	6918	*Bufotes balearicus*			max.40	p		IV

Update of the table "Other important species of flora and fauna" of the Standard Data Form

Young newly metamorphosed Italian green toads

Toad tadpoles

6956 *Lissotriton italicus* (Italian newt)

Italian newt (adult male)

The monitoring of the Italian newt was conducted in February, July, and October to examine the species' different seasonal and phenological phases. Unlike the Italian green toad, the presence of surface water within the sinkhole is not critical to the survival of the Italian newt, in fact, most of the biological cycle of the population in the SAC Laghi di Conversano area occurs within cisterns. In most monitored cisterns, water is present year-round, as evidenced by the presence of numerous paedomorphic individuals. However, most individuals do not remain in water throughout the year and move within the sinkhole and surrounding countryside. Observations near dry-stone walls and under occasional shelters, such as logs, stones, and some debris, confirm this behaviour.
The species was found in seven of the ten surveyed sites, sometimes with high densities, suggesting it remains in good conservation status. The principals sites were the Agnano, Padula, and Iavorra lakes, while it was absent in Sassano, Minuzzi and San Vito. The absence at Sassano likely indicates local extinction, attributed to multiple persistent pressures in the area (see Italian green toad), with the last sightings recorded approximately thirty years ago (Liuzzi & Lorusso, 2010). In other lakes, despite threats such as irregular summer arson events affecting all sinkholes, waste presence, illegal water collection, and chemicals used in surrounding agriculture, the species appears relatively resilient. However, the

continued impact of these factors may, over time, lead to a rapid decline, compounded by the fact that ecological corridors are often insufficient to connect with isolated populations in the surrounding landscape

Sito	Session 1 (8-29 February)	Session 2 (3-08 July)	Session 3 (1 October)
Sassano	0	0	0
Chienna	5	11	9
Iavorra	2	20	13
Agnano	49	98	70
Castiglione	2	3	6
Vignola	5	0	1
Padula	3	31	7
San Vito	0	0	0
Petrullo	0	14	3
Minuzzi	0	0	0

Summary of the surveys conducted in 2024 for the Italian newt

Species					**Population in the site**			**Motivation**
Group	**CODE**	**Scientific Name**	**S**	**NP**	**Size**	**Unit**	**Cat.**	**Species Annex**
A	6956	*Lissotriton italicus*			min. 66; max. 177	i		IV

Update of the table 3.3 "Other important species of flora and fauna" of the Standard Data Form

Italian newt larvae

1279 *Elaphe quatuorlineata* (Four-lined snake)

Four-lined snake (adult)

The monitoring of the Four-lined snake was conducted in accordance with ISPRA guidelines, utilizing standardized transects repeated across seasons, with a total of six repetitions per each of the four selected transects. The first session took place in March, and the final one in mid-September. Estimating abundance for all snake species poses challenges, and this methodology is primarily recommended to gather data on species presence and distribution within a given area. The Four-lined snake was predominantly observed in the Monteferraro wood, where both juvenile and adult individuals were found, indicating a well-structured population still in a good state of conservation. The species was also recorded in the Gravina di Monsignore, with one adult individual observed during the May session. However, no sightings were made along the two transects in Castiglione, confirming the significant decline noted in recent years (Liuzzi et al., 2013). In the past decade, the area has experienced a near-total disappearance of both the Four-lined snake and the Western green lizard, likely due to the illegal presence of a feral cat colony (now partially removed) or other, as yet unexplored, causes.
It is notable that Castiglione is the only surveyed area within the SAC Laghi di Conversano, while the Gravina of Monsignore falls within a Regional Reserve, and, paradoxically, Monteferraro is not subject to any formal protection measures.

To estimate the population within the SAC, data from this survey were supplemented with records from the period 2020-2023. These records cover both the Castiglione wood, the lakes, and the surrounding areas included within the Natura 2000 site boundary.

Sito	Session 1 (25-28 March)	Session 2 (15 April ;4 May)	Session 3 (24-25 May)	Session 4 (3-8 July)	Session 5 (13-14 August)	Session 6 (14-15 September)
Castiglione wood	0	0	0	0	0	0
Castiglione hill	0	0	0	0	0	0
Monsignore	0	0	1	0	0	0
Monteferraro	0	2	1	0	0	2

Summary of the surveys conducted in 2024 for the Four-lined snake

Species					**Population in the site**				
Group	**CODE**	**Scientific Name**	**S**	**NP**	**T**	**Size**	**Unit**	**Cat.**	Data quality
R	1279	*Elaphe quatuorlineata*			P	min. 10 max 20	i		G

Site assessment			
Pop. (A-B-C.D)	**Con. (A-B-C)**	**Iso. (A-B-C)**	**Glo. (A-B-C)**
C	C	C	C

Update of the table 3.2 "Species referred to in Article 4 of Directive 2009/147/EC and listed in Annex II of Directive 92/43/EEC and site evaluation for them" of the Standard Data Form

Four-lined snake (juvenile)

6095 *Zamenis situla* (Leopard snake)

Leopard snake (adult, leopardinus morph)

Monitoring of the Leopard snake was conducted concurrently with that of the Four-lined snake and involved six repetitions for each of the four identified transects. Reports of the species have certainly declined compared to the past decade, and investigations carried out during this project have confirmed these impressions. During the numerous hours of active searching for the species, only one individual was recorded, and notably, it was found in the Monteferraro wood, the only area without protection constraints. The population in Castiglione (within the SAC) seems to have practically vanished, with the last available data now dating back four years. While considering the elusiveness of the species, a noticeable decline appears evident, at least within the SAC perimeter; however, to obtain specific insights on this matter, prolonged studies over at least three years would be necessary. The pressures faced by the Leopard snake are multiple; in Castiglione, a significant negative effect has been caused by the presence of an illegal feral cat colony right at the wood's edge, along with herbicide practices and direct killings resulting from increased human activity recorded in recent years.
The situation is quite different in Monteferraro, which, despite the lack of protective constraints, maintains a healthy environment and does not face particular threats. To estimate the population present in the SAC, data from the current investigation were combined with data from the period 2020-2023. It should be noted

that this data pertains to both the Castiglione wood and the lakes and surrounding areas included in the Natura 2000 site perimeter.

Sito	Session 1 (25-28 March)	Session 2 (15 April ;4 May)	Session 3 (24-25 May)	Session 4 (3-8 July)	Session 5 (13-14 August)	Session 6 (14-15 September)
Castiglione wood	0	0	0	0	0	0
Castiglione hill	0	0	0	0	0	0
Monsignore	0	0	0	0	0	0
Monteferraro	1	0	0	0	0	0

Summary of the surveys conducted in 2024 for the Leopard snake

Species					**Population in the site**				
Group	**CODE**	**Scientific Name**	**S**	**NP**	**T**	**Size**	**Unit**	**Cat.**	Data quality
R	6095	*Zamenis situla*			P	min. 6 max. 10	i		G

Site assessment			
Pop. (A-B-C.D)	**Con. (A-B-C)**	**Iso. (A-B-C)**	**Glo. (A-B-C)**
C	C	C	C

Update of the table 3.2 "Species referred to in Article 4 of Directive 2009/147/EC and listed in Annex II of Directive 92/43/EEC and site evaluation for them" of the Standard Data Form

Leopard snake (adult, situla morph)

Other monitored reptiles:
1250 *Podarcis siculus* (Italian wall lizard)
5179 *Lacerta bilineata* (Western green lizard)
6958 *Mediodactylus kotschyii* (Kotschy's gecko)
5670 *Hierophis viridiflavus* (Western whip snake)
1283 *Coronella austriaca* (Smooth snake)

The execution of standardized transects has provided valuable information regarding other reptile species included in the Habitats Directive (Annex IV); indeed, the environmental types selected for identifying the areas to be surveyed are relevant to the presence of the entire herpetological community in the area. All species, except for the Smooth snake, were found. The constant decline of the Western green lizard is confirmed, as its presence within the SAC is now nearly non-existent; however, the species persists and is in relatively good conservation status in the Monteferraro area, while no individuals were found in Castiglione. Considering that in the early 2000s it was one of the most easily observable species, the decline appears quite evident. Among the few positive notes, the presence of Kotschy's gecko is highlighted, as in addition to confirming the small population at Castiglione, the species was also found in Monteferraro, where it appears to be in optimal conservation status. The Italian wall lizard and Western whip snake are the only species that exhibit good conservation status in the SAC and the surrounding territory. The subsequent tables present the results obtained for each of the surveyed species

1250 *Podarcis siculus*

Sito	Session 1 (25-28 March)	Session 2 (15 April ;4 May)	Session 3 (24-25 May)	Session 4 (3-8 July)	Session 5 (13-14 August)	Session 6 (14-15 September)
Castiglione wood	54	38	63	39	24	39
Castiglione hill	110	41	70	44	19	64
Monsignore	40	41	55	50	21	37
Monteferraro	47	30	64	42	30	49

Summary of the surveys conducted in 2024 for the Italian wall lizard

5179 *Lacerta bilineata*

Sito	Session 1 (25-28 March)	Session 2 (15 April ;4 May)	Session 3 (24-25 May)	Session 4 (3-8 July)	Session 5 (13-14 August)	Session 6 (14-15 September)
Castiglione wood	0	0	0	0	0	0
Castiglione hill	0	0	0	0	0	0
Monsignore	0	0	0	0	0	0
Monteferraro	0	0	2	1	0	1

Summary of the surveys conducted in 2024 for the Western green lizard

6958 *Mediodactylus kotschyii*

Sito	Session 1 (25-28 March)	Session 2 (15 April ;4 May)	Session 3 (24-25 May)	Session 4 (3-8 July)	Session 5 (13-14 August)	Session 6 (14-15 September)
Castiglione wood	1	1	2	1	0	0
Castiglione hill	0	0	0	0	0	0
Monsignore	0	0	0	0	0	0
Monteferraro	5	2	6	4	1	0

Summary of the surveys conducted in 2024 for the Kotschy's gecko

5670 *Hierophis viridiflavus*

Sito	Session 1 (25-28 March)	Session 2 (15 April ;4 May)	Session 3 (24-25 May)	Session 4 (3-8 July)	Session 5 (13-14 August)	Session 6 (14-15 September)
Castiglione wood	0	1	1	1	0	0
Castiglione hill	0	0	1	0	0	1
Monsignore	2	0	1	0	0	1
Monteferraro	1	1	1	1	1	2

Summary of the surveys conducted in 2024 for the Western whip snake

1283 *Coronella austriaca*

Sito	Session 1 (25-28 March)	Session 2 (15 April ;4 May)	Session 3 (24-25 May)	Session 4 (3-8 July)	Session 5 (13-14 August)	Session 6 (14-15 September)
Castiglione wood	0	0	0	0	0	0
Castiglione hill	0	0	0	0	0	0
Monsignore	0	0	0	0	0	0
Monteferraro	0	0	0	0	0	0

Summary of the surveys conducted in 2024 for the Smooth snake

Species					**Population in the site**			**Motivation**
Group	**CODE**	**Scientific Name**	**S**	**NP**	**Size**	**Unit**	**Cat.**	**Species Annex**
R	1250	*Podarcis sicula*					C	IV
R	5179	*Lacerta bilineata*					V	IV
R	6958	*Mediodactylus kotschyii*					R	IV
R	5670	*Hierophis viridiflavus*					C	IV
R	1283	*Coronella austriaca*					V	IV

Update of the table 3.3 "Other important species of flora and fauna" of the Standard Data Form

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Italian wall lizard (adult male, concolor morph)

Western green lizard (adult male)

Kotschy's gecko (adult)

Western whip snake (juvenile)

Pressure/ threat to amphibians and reptiles in the SAC IT9120006

Pressure/ threat code	*6918 Bufotes balearicus*	*6956 Lissotriton italicus*	*1279 Elaphe quatuorlineta*	*6095 Zamenis situla*	*1250 Podarcis sicula*	*5179 Lacerta bilineta*	*6959 Mediodactylus kotschy*	*1283 Coronella austriaca*	*5670 Hierophis viridiflavus*
PA02									
PA04									
PA14									
PA21									
PB10									
PE01									
PG11									
PH04									
PI01									
PI02									
PI03									

Red= High; Yellow= medium; Green= low; White= no pressure/threat

PA02 = Conversion from one type of agricultural land use to another (excluding drainage and burning)
PA04 = Removal of small landscape features for agricultural land parcel consolidation (hedges, stone walls, rushes, open ditches, springs, solitary trees, etc.).
PA14 = Use of plant protection chemicals in agriculture.
PA21 = Active abstraction of water for agriculture.
PB10 = Illegal logging.
PE01 = Roads, paths, railroads and related infrastructure.
PG11 = Illegal shooting/killing.
PH04 = Vandalism or arson (incl. human-introduced wild fire).
PI01 = Invasive alien species of Union concern.
PI02 = Other invasive alien species (other than species of Union concern).
PI03 = Problematic native species

3. CONCLUSIONS

The field research conducted by botanists and zoologists in “Laghi di Conversano” in many works since 2012, adopted in the Standard Data Form of 2019 and 2023, and our study conducted in 2024 suggest further investigations to update and check the information on the state of terrestrial habitats, specifically for priority habitat 6220*, while the habitat of the temporary ponds 3170* and of the benthic vegetation of Chara spp. 3140 on which this Natura 2000 site was established are extinct. As a consequence the following species linked to temporary ponds have disappeared: *Damasonium alisma, Eryngium pusillum, Teucrium campanulatum*, while some doubts persist for *Verbena supina* whose possible presence presence would be limited to Castiglione.
The priority Habitat 3170* has been replaced by nitrophilous and sub-nitrophilous habitats and by the *Paspalum paspaloides* weedy vegetation, at least for some lakes.
They are confirmed the evergreen wood habitats (*Quercus ilex* and *Quercus rotundifolia* forests - code 9340) and *Quercus trojana* woods (code 9250) with the addition of “Eastern white oak woods” habitat (code 91AA*) only for Castiglione.
Intensive agricultural management activities are increasingly less sustainable, as was observed at Lake Iavorra where plowing with a tractor was carried out in May which caused a damage to a well, after restored. The combination of these events, inappropriate use of water well for agricultural purposes, illegal fires, waste disposal and finally the climate change such as the decrease of average rainfall, especially in dry period (summer season), had a negative effect on natural vegetation with the disappearance of wetland vegetation and their characteristic plant species.
Based on the results and/or evidences of the researches conducted in the present study, it would be necessary to follow the following guidelines o recommendations for the conservation and restoration of terrestrial habitats and living species:
- update the cartography of habitats and their distribution at lakes level;
- update the Natura 2000 card with the inclusion of new habitat 91AA* and extinction of habitat 3170*;
- monitoring every three years for all habitats and species of conservation interest;
- reintroduction actions of extinct plant species (*Damasonium alisma, Eryngium pusillum, Verbena supina* and *Teucrium campanulatum*) by germplasm from the closest stations;
- restoration actions of habitat 3170*, checking the best suitable lakes, as Castiglione, Iavorra, Agnano and San Vito;
- restore gradually the naturalness of Lake Sassano, removing alien species and reintroducing native ones;
- interdict the extraction of water from lake wells, which must be used to moisten the soil in the dry period;
- interdict entrance to the lakes for everyone except for maintenance reasons, studies and actions aimed to promote the restoration of wild vegetation;
- update the panels for each lake with access restrictions;
- management staff with local experts involving local environmental associations.

Data from the monitoring of herpetofauna present a critical condition, especially for some species. Strangely, the area of greatest interest for reptiles and woods vegetation is Monteferraro, currently not under any protection. Many animal are closely linked to the presence of suitable habitats for their survival, and it is crucial to evaluate specific conservation/restoration actions. The degradation level of many sinkholes, the scarcity of water, and the wood and scrub environments status, influence negatively the reptiles and amphibians populations in the area, leading to their partial disappearance in the SAC, such as the Four-lined snake, the Western green lizard, and especially the Italian green toad, are signals that

must not be ignored. Future conservation measures must be carefully calibrated to recover these populations.
The Italian green toad population at "Laghi di Conversano", considered until few years ago one of the most important site at the national level (Frisenda & Manghisi, 1986; Frisenda & Orofino, 1984; Liuzzi et al., 2008; Todisco et al., 2011; Todisco & Liuzzi, 2016), is drastically reduced, with high mortality amount caused by vehicular traffic near breeding sites (current pressure), although this pressure is well known for over 20 years.
A positive result is the good condition of the Italian newt population, still well represented in most of the lakes, threatened in the past by illegal practices such as water extraction from cisterns, washing cars and agricultural tolls storage directly in the sinkholes. The actions undertaken by the management authority, as the closure of the sinkholes with dry stone walls and/or fences and the installation of fixed gates, has proven helpful with high decrease of water extraction from the wells.
The small size population of reptiles at Castiglione is hard to evaluate, probably was caused by the presence of an illegal cat population near the tower or more likely from other pressures, such as illegal agricultural practices, fire, and direct killings to increase the tourist activity.

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HABI

A Review of Marine Habitat Types and Species Research in the Lokrum HR4000017 Ecological Network Area (2018-2023)

Dubrovnik, December 2023.

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Contents

1. INTRODUCTION

Public institution “Lokrum reserve” manages the protected area of nature - Lokrum Island, a special reserve of forest vegetation, which is protected in accordance with the Nature Protection Act in the special reserve of forest vegetation category since 1948, and as such is the third oldest protected nature area in Croatia whose basic phenomenon is forest vegetation covering about 90% of the island. The vegetation cover is considered representative as all the growth series of plant communities of the southern phytogeographical area – Eumediterranean – are present on a very small surface area (72 ha), which is the main reason for the protection of this area of nature.
According to the Regulation on the Ecological Network, since 2018. the entire Island of Lokrum, including the belt of the sea of about 150 meters from the coast, is also an area of the Natura 2000 ecological network (HR4000017 Lokrum) – a conservation area of importance for species and habitat types (POVS) for a total of eight habitat types including marine habitat type Posidonia beds (Posidonion oceanicae) and reefs (Photo 1).

The area of the island of Lokrum is also an integral part of the Historic core of the City of Dubrovnik with the defensive walls and fortifications and the city moat and is included in the UNESCO World Heritage List. Lokrum Island and its waters are protected as a cultural good by the Decision on the Protection of the Historical Complex of the City of Dubrovnik and its Immediate Surroundings (Register of Cultural Goods of the Republic of Croatia - Code Z-3818) based on the Act on the Protection and Preservation of Cultural Goods. Zones were established in accordance with the same Decision on the Protection of the Historical Complex of the City of Dubrovnik and its Immediate Surroundings, and the island of Lokrum with its waters was included in the “A” zone, described as a “complete protection of historical structures”.

Lokrum island, special reserve of forest vegetation, is protected in accordance with the Nature Protection Act in the special reserve of forest vegetation category since 1948, and as such is the third oldest protected nature area in Croatia whose basic phenomenon is forest vegetation covering about 90% of the island.
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According to the Regulation on the Ecological Network, the entire island of Lokrum, including the belt of sea of about 150 meters from the coast, is also an area of the Natura 2000 ecological network (HR4000017 Lokrum) – a conservation area of importance for species and habitat types (POVS) for a total of eight habitat types **(Table 1).**

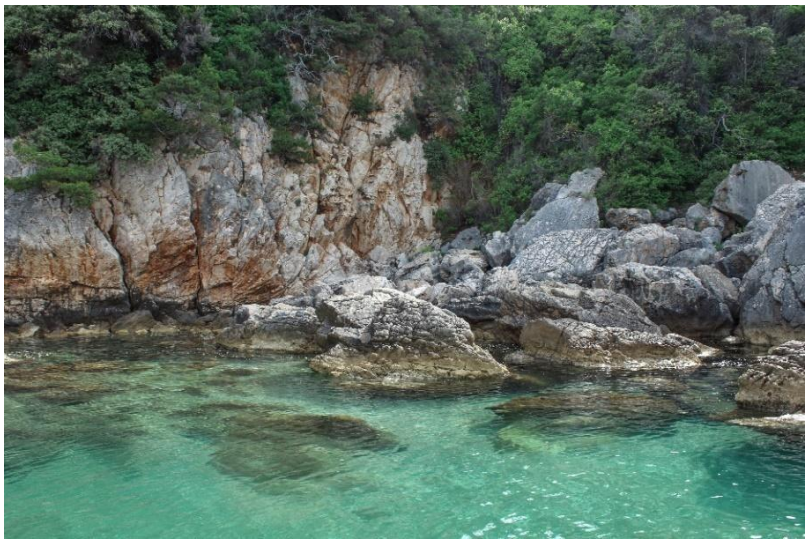

Photo 1 Natura 2000 Reefs and Mediterranean forests of endemic pines

Table 1. Conservation areas of importance for species and habitat types (POVS)

Area code	Area name	Habitat type	Natura code
HR 4000017	Lokrum	Posidonia beds (*Posidonion oceanicae*)	1120
		Reefs	1170
		Rocks and steeps (scliffs) of the Mediterranean coast overgrown with the endemic species *Limonium* spp.	1240
		Eumediterranean grasslands Thero-Brachypodietea	6220
		Carbonate rocks with chasmophytic vegetation	8210
		Submerged or partially submerged sea caves	8330
		Evergreen forests of the holm oak (*Quercus ilex*)	9340
		Mediterranean forests of endemic pines	9540

The area of the island of Lokrum is also an integral part of the *Historic core of the City of Dubrovnik with the defensive walls and fortifications and the city moat*, and is included in the UNESCO World Heritage List. Lokrum Island and its waters are protected as a cultural good by the Decision on the Protection of the Historical Complex of the City of Dubrovnik and its Immediate Surroundings (Register of Cultural Goods of the Republic of Croatia - Code Z-3818) based on the Act on the Protection and Preservation of Cultural Goods. Zones were established in accordance with the same Decision on the Protection of the Historical Complex of the City of Dubrovnik and its Immediate Surroundings, and the island of Lokrum with its waters was included in the “A” zone, described as a “complete protection of historical structures”.

2. METHODOLOGY

Field exploration of the underwater area and activities aimed at preserving the marine habitats of the Lokrum Island, a special forest vegetation reserve and a Natura 2000 ecological network site (site code: Lokrum HR4000017). The exploration activities were carried out by the Sunce Association[1] with the professional and logistical support of the employees of the Lokrum Reserve Public Institution[2] (**Errore. L'origine riferimento non è stata trovata.**). In addition to field exploration, other activities are performed as well, including the activities aimed at preserving the noble pen shell in the Adriatic Sea, organisation of educational workshops and professional lectures on a regular basis, and execution of underwater and coastal cleanup campaigns (Table 1).

Photo 2 – Lokrum Island

Activities carried out since 2018 in an effort to protect and preserve the marine habitat types and species within the Lokrum Island Special Forest Vegetation Reserve:

- a map of the habitat types and species identified within the Lokrum HR4000017 ecological network site was created in 2018,
- since 2020, the Lokrum Reserve Public Institution has been actively involved in the *Preservation of the Noble Pen Shell (Pinna nobilis) in the Southern Part of the Adriatic Sea*[3] project, part of the national programme for the preservation of the noble pen shell in the Adriatic Sea,
- various underwater and coastal cleanup campaigns have been carried out,
- various educational workshops and professional lectures have been organised and carried out with the aim of informing the public about the importance of protecting and preserving different marine habitat types and species.

[1] cro. *Udruga Sunce*
[2] cro. *Javna ustanova „Rezervat Lokrum"; JU Rezervat Lokrum (JURL)*
[3] cro. *Projekt zaštite i očuvanja morskih stanišnih tipova i vrsta u južnom dijelu Jadrana*

Table 1 – An overview of explorations and activities carried out in an effort to protect and preserve the marine habitat types and species identified within the Lokrum Island Special Forest Vegetation Reserve[4]:

	Name of Explorations and Activities	**Duration**
1	Mapping of the Marine Habitats and Species Identified within the Lokrum HR4000017 Ecological Network Site (Sunce Association)	2018
2	Preservation of the Noble Pen Shell (Pinna nobilis) in the Southern Part of the Adriatic Sea (JURL)	2020 – 2025
3	Underwater and coastal cleanup campaigns	2018 – 2023
4	Educational workshops and professional lectures	2018 – 2023

[4] cro. *Poseban rezervat šumske vegetacije „Otok Lokrum“*

3. RESULTS

3.1. Mapping of the Marine Habitats and Species Identified within the Lokrum HR4000017 Ecological Network Site

The data about the habitats and species existing in the underwater area of the Lokrum Island were collected through field research carried out in the period from 14-17 September 2018. The research activities were organised by the Sunce Association for Nature, Environment and Sustainable Development[5]. Such mapping represents an important precondition for establishing a system for monitoring the state of Posidonia seagrass (*Posidonia oceanica*) meadows and the state of different protected species, such as the noble pen shell (*Pinna nobilis*), as well as for the adoption of appropriate management plans for this particular ecological network site (Natura 2000) and monitoring of the implementation of those plans (Sunce Association, 2018).

The purpose of the research was to map the marine habitats existing in the north-western part of the Lokrum Island and to determine, within that area, the potential locations for monitoring the state of the Posidonia beds and the state of noble pen shells.

The marine section of the Lokrum Island, i.e., the marine area within the radius of 100 m from the coast, has been identified as an ecological network site, Lokrum HR4000017. The Lokrum Island underwater area has been declared a special area of conservation within an ecologic network site with the aim of preserving three habitat types of Community importance, i.e., 1120 Posidonia beds, 1170 Reefs, and 8330 Submerged or partially submerged caves (Sunce Association, 2018).

In the *Natura 2000 Standard Data Form*, several pressures on the environment were named in connection with this site in 2012 – port areas and marine constructions, mariculture, trawling, fishing, diving activities, marine pollution, and invasive species. During the field activities carried out in 2018, the presence of the mariculture and trawling pressures was not confirmed in the mapped area.

The invasive algae species *Caulerpa cylindracea* was, however, sighted on all research locations.

During the research activities, damage to Posidonia beds caused by anchoring was identified in the Portoč bay area and between the Donja ponta cape and the Portoč bay (Sunce Association, 2018).

A small anthropogenic habitat, i.e., a built boat docking area, was also identified in the Portoč bay. The likeliness of formation of small biocenoses of the sedimentary bed (e.g. fine, well-sorted sands) was also identified in that area.

The bed damage identified in the Portoč bay area refers to ripped shoots, the whole turfs, which is very likely a consequence of anchoring, an activity which is common in the area.

[5] cro. *Udruga za prirodu, okoliš i održivi razvoj Sunce*

In the same area, large fragments of the sedimentary bed were also found, with clearly visible Posedonia mattes and communities of the noble pen shell (*Pinna nobilis*).

Small-scale damage caused by anchoring was also identified in the sheltered area between the Donja ponta and Bijela seka capes.

Well-preserved Posidonia beds were found west of the Donja ponta cape.

Considering the determined state of the investigated areas, the Portoč bay and the area west of the Donja ponta cape have been identified as proposed sites for monitoring the state of Posidonia beds. The Portoč bay has also been identified as a proposed site for monitoring the state of the noble pen shell, and for conducting further underwater cleanup campaigns (Sunce Association, 2018).

It has been determined that the structure of the marine litter that accumulates in different locations depends greatly on particular factors, such as the purpose for which the location is used, e.g., for recreational purposes or as a docking area, and exposure of the location to different sea currents (Sunce Association, 2018).

3.2. Sea and Coast Cleanup Campaigns

Since 2018, the Lokrum Reserve Public Institution has organised and carried out six underwater and coastal cleanup campaigns in the Portoč bay and on the southwestern side of the Lokrum Island. More than 640 kg of different types of waste was removed from the sea, and more than 296 kg from the coast (Table 3).

In cooperation with various Dubrovnik-based associations and the Dubrovnik Diving Club, the Lokrum Reserve Public Institution organised on 2 June 2018 an underwater cleanup campaign in the Portoč bay area of the Lokrum Island. 150 kg of waste was removed from the sea.

As part of the ML-REPAIR project, implemented by the Split Institute of Oceanography and Fisheries[6], the Lokrum Reserve Public Institution organised on 15 September 2018, in cooperation with the Dubrovnik Diving Club, an underwater and coastal cleanup campaign on the Lokrum Island. 100 kg of various types of waste was removed from the Portoč bay underwater area, and another 110 kg from the coast.

As part of the *World CleanUp Day*, the Administrative Department for Urban Planning, Spatial Planning and Environmental Protection of the City of Dubrovnik[7], organised on 28 September 2019, in cooperation with the Lokrum Reserve Public Institution, an underwater and coastal cleanup campaign on the Lokrum Island. Campaign participants included the members of the Dubrovnik Diving Club and HPD Dubrovnik Mountaineering Club[8], students and professors from the Dubrovnik Gymnasium, the Dart Association, Lovers of Croatian Traditions and Natural Values Association[9], Association of Croatian Defenders of

[6] cro. *Institut za oceanografiju i ribarstvo*
[7] cro. *Upravni odjel za urbanizam, prostorno planiranje i zaštitu okoliša Grada Dubrovnika*
[8] cro. *Hrvatsko planinarsko društvo Dubrovnik*
[9] cro. *Ljubitelji hrvatskih tradicija i prirodnih ljepota*

Dubrovnik[10], Dubrovnik Red Cross Branch, Klub 65, and numerous other fellow citizens. 250 kg of various types of waste was removed from the water, and another 150 kg from the coast.

As part of the *World CleanUp Day*, the Administrative Department for Urban Planning, Spatial Planning and Environmental Protection of the City of Dubrovnik, organised on 19 September 2020, in cooperation with the Lokrum Reserve Public Institution, an underwater and coastal cleanup campaign on the Lokrum Island (Photo 3). Campaign participants included the members of the Dubrovnik Natural History Museum[11], the University of Dubrovnik, and members of the Dubrovnik Diving Club. 84 kg of various types of waste was removed from the water, and another 10 kg from the coast.

The employees of the Lokrum Reserve Public Institution organised an underwater and coastal cleanup campaign on the Lokrum Island that took place on 22 May 2021. Campaign participants included the Croatian Red Cross and members of the Epidaurum Diving Club.

As part of the *World CleanUp Day*, the Administrative Department for Urban Planning, Spatial Planning and Environmental Protection of the City of Dubrovnik, organised on 18 September 2021, in cooperation with the Lokrum Reserve Public Institution, an underwater and coastal cleanup campaign on the Lokrum Island. Campaign participants included the Dubrovnik Diving Club, the Dubrovnik Natural History Museum, the University of Dubrovnik, the DUNEA Regional Development Agency, and members of the Lovers of Croatian Traditions and Natural Values Association. 56 kg of various types of waste was removed from the water, and another 26 kg from the coast.

Table 3 – An overview of the Lokrum Island underwater and coastal area cleanup campaigns

Date	**Quantity of waste removed from the sea (kg)**	**Quantity of Waste removed from the coast (kg)**	**Type of waste**
02/06/2018	150	/	90% plastic waste (mainly polystyrene, plastic bottles, plastic packaging, nylon)
15/09/2018	100	110	Plastic waste – 20%, cans – 50%, glass – 15%, and metal – 15%
28/09/2019	250	150	Type analysis was not performed
19/09/2020	84	10	90% plastic waste
22/05/2021	No available data	No available data	Type analysis was not performed
18/09/2021	56	26	80% plastic waste

[10] cro. *Udruga hrvatskih branitelja Dubrovnika*
[11] cro. *Prirodoslovni muzej Dubrovnik*

Photo 3 – Underwater cleanup campaign

3.3. Preservation of the Noble Pen Shell (*Pinna nobilis*) in the Southern Part of the Adriatic Sea Project

In October 2020, the Lokrum Reserve Public Institution signed a partnership agreement with regard to the implementation of the *Preservation of the Noble Pen Shell (Pinna Nobilis) in the Southern Part of the Adriatic* project[12], part of the national programme for the preservation of the noble pen shell in the Adriatic Sea. The activities aimed at preserving the noble pen shell in the Croatian part of the Adriatic Sea, being carried out under three subprojects, are coordinated by the Institute for Environmental and Nature Protection[13] of the Ministry of Economy and Sustainable Development[14], and co-financed by the Environmental Protection and Energy Efficiency Fund[15].

The relevant subprojects are being implemented by the Sea and Karst Public Institution[16] (for the area of Southern Adriatic), the Telašćica Nature Park Public Institution [17] (for the area of Central Adriatic), and the Brijuni National Park Public Institution[18] (for the area of Northern Adriatic). In cooperation with various partners, these institutions coordinate and carry out the noble pen shell preservation activities at the regional level.

The state of the noble pen shell (*Pinna nobilis*) population in the Adriatic and the rest of the Mediterranean is alarming, and the survival of this Mediterranean endemic bivalve is uncertain. Considering the degree of endangerment and the synergic effect of different threats (three pathogens – *Haplosporidium pinnae*, a

[12] cro. *Očuvanje plemenite periske (Pinna nobilis) u južnom dijelu Jadranskog mora*
[13] cro. *Zavod za zaštitu okoliša i prirode*
[14] cro. *Ministarstvo gospodarstva i održivog razvoja*
[15] cro. *Fond za zaštitu okoliša i energetsku učinkovitost*
[16] cro. *Javna ustanova More i krš*
[17] cro. *Javna ustanova Park prirode Telašćica*
[18] cro. *Javna ustanova Nacionalni park Brijuni*

parasite, and *Mycobacterium* sp. and *Vibrio Spp.*, bacteria), including the global climate change, i.e. the average increase in sea temperature (most particularly at depths usually recording lower temperatures) contributing to the spread of carriers of disease and high mortality rate, it is imperative to take urgent measures to preserve this species and help the remaining specimens adapt to the new conditions in an effort to prevent the extinction of the species, all the more so because the noble pen shell (*Pinna nobilis*) is considered a strictly protected species in Croatia pursuant to:

- Nature Protection Act[19],
- Regulation on Strictly Protected Species[20],

and the species is also listed in:

- Annex IV of the Habitats Directive, and
- Annex II of the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean, Convention on the Protection of the Mediterranean Sea against Pollution (i.e., the Barcelona Convention), and

- in October 2019, the International Union for Nature Conservation (IUCN) classified the noble pen shell in the Critically Endangered (CR) category.

The data show that the phenomenon of mass mortality has affected the entire Croatian part of the Adriatic Sea. Given the experiences of other Mediterranean countries, it is necessary to implement preservation measures to prevent the extinction of the noble pen shell. Furthermore, considering the declining number of living individuals of the species in the sea, it is crucial for the survival of the species to find potentially resistant individuals that could further reproduce and create natural “immunity”. As it stands, it is believed that the potentially resistant individuals should better be left in their natural habitat and that adequate protection against anthropogenic activity must be ensured in that case. Furthermore, besides the measures aimed at protecting the surviving adults, another measure is currently also being implemented throughout the Mediterranean, including Croatia (with the help of the scientific and professional community), i.e., the installation of larval collectors and the physical protection of the collected individuals from anthropogenic activity or natural predators, which should result in an increase in the larvae survival rate. Some of the collected larvae could be relocated to aquariums. The Pula Aquarium currently houses several living adult noble pen shells, which are kept in quarantine pools. Efforts must be taken to keep them alive and encourage their *ex-situ* reproduction.

As part of this project, the Lokrum Reserve Public Institution carries out various activities aimed at preserving the noble pen shell on a regular basis:

- inspection of the underwater area and search for the living individuals,
- installation of three lines with three collectors for catching noble pen shell juveniles,
- collector checks and inspection of their condition,

[19] cro. *Zakon o zaštiti prirode*
[20] cro. *Pravilnik o strogo zaštićenim vrstama*

- removal from water and processing of the collectors used to catch noble pen shell juveniles,
- educational workshops on the importance and significance of this endemic species in marine systems.

3.4. Educational Workshops and Professional Lectures:

In cooperation with various scientific and professional institutions, the employees of the Lokrum Reserve Public Institution regularly carry out various educational programmes and professional lectures highlighting the importance of nature protection. The purpose of such programmes is to inform the public and raise the awareness of the importance of preserving and protecting different habitat types and species.

Since 2018, seven professional lectures on the preservation of marine habitats and species have been held (Table 4), and the four educational programmes presented below in Table 5 are conducted on a regular basis.

Table 4 – An overview of professional lectures held on the topic of the importance of marine habitat preservation

Professional lectures	
Name of Lecture	**Number of Participants**
Postupanje/Protokol u slučaju nalaza strogo zaštićenih morskih vrsta kornjača, sisavaca i ptica / Conduct/Protocol in Case of Identifying a Strictly Protected Marine Turtle, Mammal or Bird Species (University of Dubrovnik, Dubrovnik-Neretva County Public Institution)	15
Organizacija ronilačkog terenskog rada u zaštićenim područjima / Organisation of Fieldwork Diving in Protected Areas (Sunce Association)	10
Okrugli stol o otpadu iz mora i prezentacija projekata vezanih za njegovu problematiku / A Round Table on Marine Litter and Presentation of Related Projects (ML-REPAIR), Institute for Oceanography and Fisheries	40
Prezentacija istraživanja Kartiranje morskih staništa i vrsta područja ekološke mreže Lokrum HR4000017 / Research Presentation: Mapping of the Marine Habitats and Species Identified within the Lokrum HR4000017 Ecological Network Site (Sunce Association)	70
Festival znanosti – Nijanse plićaka / Science Festival – The Nuances of Shallow Waters (University of Dubrovnik, Aquaculture Department)	20
Prezentacija rezultata istraživanja Mrtvog mora tijekom 2017. i 2018. / Presentation of the Results of the Dead Sea Research Carried out in 2017 and 2018 (University of Dubrovnik, Aquaculture Department)	20
Bioraznolikost Jadrana / Biodiversity of the Adriatic, a lecture held on the occasion of the International Day for Biodiversity and Nature Conservation Day (University of Dubrovnik, Aquaculture Department)	30

Table 5 – An overview of educational programmes conducted on the topic of importance of marine habitat preservation

Educational Workshops		
Programme Name	**Number of Workshops Held**	**Number of Participants**
Nek plavo ostane plavo / Let the Blue Stay Blue	6	308
Upoznaj more, očuvaj Jadran! / Learn about the Sea, Preserve the Adriatic!	2	52
Podmorje Lokruma / Lokrum Underwater Area	4	140
Epinnademija – Očuvanje plemenite periske (*Pinna nobilis*) / *Epinnademija* – Preservation of the Noble Pen Shell (*Pinna nobilis*)	5	253

Photo 4 – Epinnademija workshop

Photo 5 – Neka plavo ostane plavo / Let the Blue Stay Blue workshop

4. CONCLUSIONS

Analyzing the results of the field research on marine habitats and species on the island of Lokrum conducted by the Sunce Association in September 2018, there is a highlighted need for further investigations to update information on the state of marine habitats, especially Posidonia meadows. Given the dynamics of the marine environment, a new survey is essential to refresh information on the condition of Posidonia meadows, particularly in Portoć Bay, and to identify current pressures and changes in anthropogenic influences, including the status of invasive species. With changes in recreational activities, boat harbors, and marine currents, it is crucial to gather new data on the distribution of marine litter and identify potential new environmental pressures.
While the Natura 2000 Standard Data Form from 2012 identifies environmental pressures, these data need to be updated to provide an accurate picture of current threats to the Lokrum ecosystem.
Based on new research, there is a need to define new guidelines for the conservation of marine habitats and species on Lokrum, concurrently establishing precise monitoring protocols. This will enable systematic tracking of changes and prompt action in the face of new threats.
While previous research has offered valuable insights into the ecological status of the Lokrum marine area, it is imperative to conduct further investigations to obtain updated information. This step is crucial for setting conservation goals, defining management measures, and achieving the long-term sustainability of this exceptional ecosystem.

Lokrum Island is the closest protected area of nature and Natura 2000 site to the Old town of Dubrovnik, providing the community of residents and a high number of tourists with all the ecosystem services that nature provides - regulating services such as climate, water, air quality, and cultural services such as educational, aesthetic, natural and cultural heritage values, recreation, and tourism. With crystal clear sea water and natural beaches, it is also attractive and popular for marine activities and is exposed to various pressures. Considering the forecited roles and value of Lokrum Island, as well as the possible negative impact of mass tourism, the conservation of biodiversity and its ecosystems and preventing any kind of deterioration has high priority in the planning and management of this valuable site.

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[21] cro. *Državni zavod za zaštitu* prirode
[22] cro. *Hrvatsko ekološko društvo*
[23] cro. *Hrvatsko društvo za biološka istraživanja*

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[24] cro. *Zakon o izmjenama i dopunama Zakona o zaštiti prirode*
[25] cro. *Narodne novine*
[26] cro. *Zakon o zaštiti prirode*
[27] cro. *Pravilnik o popisu stanišnih tipova i karti staništa*
[28] cro. Uredba o ekološkoj mreži i nadležnostima javnih ustanova za upravljanje područjima ekološke mreže.
[29] cro. *Pravilnik o strogo zaštićenim vrstama*

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HABI

SCIENTIFIC RESEARCH ACTIVITIES ON SPECIES AND HABITAT OF COMMUNITY INTEREST: Zerynthia cassandra (Lepidoptera, Papilionidae) and Euplagia quadripunctaria (Lepidoptera, erebidae): implications for their conservation.

CONVERSANO, OCTOBER 2024

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Project title: Awareness raising, training, and scientific research activities on species and Habitat of Community interest

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Introduction

The study was carried out to verify the presence/absence of two species of Lepidoptera: the butterfly *Zerynthia cassandra* and the moth *Euplagia quadripunctaria*. The species of butterfly is mentioned in Annex IV of the Habitats Directive 92/43 EEC, instead the moth species is mentioned in Annex II of the same Directive (species of community interest whose conservation requires the designation of special conservation areas). Both species are not threatened but the low spread capacity makes their populations vulnerable to fragmentation, and therefore require rigorous protection, as provided for in the Community annexes. This study can be useful to gain informations on the populations of these two insects and deemed particularly useful for planning the conservation of the species and providing useful guidelines for the management of their habitats. The study was carried out in the spring of 2024 for what concern *Z. cassandra*, and in the summer of the same year for what concern *E. quadripunctaria*.

Materials and methods

The study site

The ‘‘Laghi di Conversano e Gravina di Monsignore ’’Regional Park is in Apulia, in the southeast of the Italian peninsula. The Natural Park area consists of a set of ten karst ponds (dolines) located in a fragmented agricultural matrix (Altini et al. 2007). Populations of *Z. cassandra* and *E. quadripunctaria* are here under threat from habitat loss by anthropogenic disturbance and spread of vineyards.

The study species

Z. cassandra is a colorful butterfly which belongs to the Papilionidae family. It is single brooded and the flight period of adults spans from late February, in Sicily, to the beginning of June, depending on altitude and latitude (Verity 1947; our data), with hibernation diapause in the pupal stage. In the study site of “Laghi di Conversano”, the adults fly period begin on late March and finish on the half of April. It occupies most of the Peninsula, starting from the Po river and as far south as Calabria, as well as in Sicily. During the flight period, which lasts around 15 days, females lay eggs on the *Aristolochia* leaves. In Italy, larvae generally feed on *A. rotunda* or *A. pallida*, which always grow in small scattered stands within semi-natural ecotonal grasslands. Populations of all *Zerynthia* species are restricted to micro-habitats where their larval food plants (*Aristolochia* spp.) grow, and their restricted, spots-like distribution, is probably related to host plants ’distribution, even though *Zerynthia* populations are generally much rarer than those of their food-plants. Adults of *Z. cassandra* do not move over great distances and seldom fly far from their reproductive areas in search of suitable host plants.

E. quadripunctaria was described by the Austrian entomologist Nikolaus Poda von Neuhaus in 1761; it belongs to the Erebidae family, subfamily Arctiinae, and it is distributed throughout Europe, with the exception of the Scandinavian countries and most of the British Isles, reaching, through Greece and Turkey, up to Iran and Turkmenistan. In Italy this brightly colored and easily recognizable moth is widespread from sea level up to approximately 2000 m. It is found especially near wooded environments, particularly those with greater tree cover, characterized by a cool and humid microclimate. In the Mediterranean area it is often associated with mature holm oaks (*Quercus ilex*). The adult is active both during the day and at night. Emergence occurs in July and the flight period goes from July to August. The egg, laid at the beginning of autumn, hatches after about two weeks. The species is polyphagous in the larval stage and feeds on a large number of herbaceous and shrubby species: in warmer places the larva is particularly frequent on *Spartium junceum*, and is possible encounter it especially at night; it also feeds on *Urtica* sp., *Taraxacum* sp., *Plantago* sp, *Carpinus betulus*, *Nicotiana glauca*. Nymphosis occurs at the beginning of summer and lasts about a month. In the summer period only the adult stage can be found.

The methodology

Several adult citizens and school classes (of all levels) have been involved in these participatory scientific monitoring activities, so this study can be assume a form of a citizen science research (Figures 1, 2 and 3). The studies have been conducted through the scientific investigation methodologies of “transects” (Pollard & Yates 1993) and “light trap”. In a period of important environmental changes, such as the climatic one, in which more and more young are involved and sensible in these issues, citizen science help them to obtain a conscious and collective participation in environmental management.

As regards the research sites, two transects were added to the vegetation, amphibians and reptiles ones (“Sassano Lake and Butterfly Garden” and “Montepaolo Lake”). This because of the presence of the host plant of the larval stages, specifically the genus *Aristolochia* (Figure 4)

- “Castiglione wood”: wood habitat with sunny meadows along a gentle landscape slope (Figure 5);

- “Castiglione hill”: wood habitat (principally *Q. ilex* and *Quercus pubescens*) with meadows on the top of a hill (Figure 6);

- “Gravina di Monsignore”: wood habitat with a dense vegetation (principally *Q. ilex*) in a rock gorge (Figure 7);

- “Monteferraro”: wood habitat with oak trees (principally *Q. ilex* and *Quercus trojana*) (Figure 8);

- "Sassano Lake and Butterfly Garden": the transect includes the area of the doline and the area of the butterfly garden, an area used in the past as an unlawful waste release site and subsequently restored by Public Institution of Municipality of Conversano with WWF. These two important areas are connected by ecological corridors, specifically made by dry stone walls and the associated vegetation (Figure 9);

- "Montepaolo Lake": wood and meadow habitats taking place on the slope near the doline (Figure 10).

The transects have been investigated weekly booth for the *Z. cassandra* and *E. quadripunctaria*. For what concern *Z. cassandra*, the research focused on presence of adults, eggs and caterpillars on the host plant, walking the transects (Figures 11, 12, 13 and 14). Otherwise for *E. quadripunctaria*, two different methods have been used: the adults have been searched both by walking the transects with entomological nets in the morning and by the positioning of a moth light trap to attract them in the night.

On June 2024, the experts involved in the HABI research program took part in a workshop in Conversano (Puglia) that foresaw a sensory journey in nature. Its aim was to encourage the use of the five senses for the observation of the typical fauna and flora of Puglia (Figure 15). At the same time, the participants have been involved in the entomological scientific research, to test their ability on catching and identifying butterflies and moths (Figures 16 and 17).

Results

The research highlights that both species of Lepidoptera are present in the area, and especially in two of the transects examined: "Castiglione wood" and" Gravina di Monsignore".

As regards *Z. cassandra*, three of the vital stages have been found: egg, larva and adult (Figure 18). The chrysalis is quite impossibile to find in nature cause of its high level of mimicry. This species is present in the following transects: "Castiglione woods", "Monteferraro", "Sassano Lake and Butterfly Garden" and "Montepaolo Lake". The adults have been found from 14th of March ("Monteferraro") until the 8th of April ("Castiglione wood"); the eggs have been laid from 19th of March ("Montepaolo Lake") until the 16th of April ("Montepaolo Lake"); the caterpillars have been found from the 5th of April ("Sassano Lake and Butterfly Garden") until the 14th of May ("Castiglione wood"). Table 1 shows the data about *Z. cassandra.*

As regards *E. quadripunctaria*, only the adult stage was detected (Figures 19 and 20). This species populates "Castiglione wood" and "Gravina di Monsignore" transects. Table 2 shows the data about *E. quadripunctaria*. The adults have been caught exclusively with the entomological nets. As required by the ISPRA manual (Stoch et al. 2016), the use of the light trap (Figure 21) did not lead

to considerable results. Anyway the moth light trap turned out very useful to attract many different species of moths (Figure 22) and some other taxa, such as the family Elateridae (Figure 23) of the order Coleoptera. Its important underlines that the number of individuals found highlights its precarious survival.

Conclusions

Causes for the widespread decline of many European butterfly species are primarily recognised in habitat degradation and loss (Maes and Van Dyck 2001; Van Swaay et al. 2010). At least in principle, however, any perturbation of the environment can negatively affect species survival and may be at the core of many extinction processes. As Samways (2007) suggests, strategies for insect conservation must be planned at regional scale, to reduce locally negative impacts. Stenotopic and univoltine butterfly species are particularly threatened worldwide by habitat destruction and climate change, most particularly at the edges of their range (Bonelli et al. 2011). Habitat changes have even stronger negative effects on species with low dispersal ability, including many terrestrial invertebrates (Thomas et al. 2004) such as the Papilionidae species of the genus *Zerynthia*.

Further studies are needed to investigate the dispersal capabilities of the species examined and to provide an action plan aimed at their protection. To counteract the currently heavy fragmentation, suitable habitats should be created within the framework of current agro environmental schemes, to ensure host plant stands connectivity.
In south Italy, *Aristolochia* plants mainly grow on dry stone walls. These important landscape elements in this area will act as stepping stones, besides their widely importance in the aesthetic and cultural dimension. Current promotion policies officially aimed at preserving dry stone walls need to be better implemented to prevent any further loss of this irreplaceable asset, at communitarian level.

In general, schemes based on the application of the integrated organic production rules financed by Rural Development Programs will be less impacting for butterfly populations occurring in cultivated areas and particularly in vineyards. These include the insertion of buffer stripes between the fields, the (cyclical) abandonment of some mown areas and the encouragement of spontaneous revegetation in the alleyways and areas around crops.

We also agree with Thomas et al. (1992) and with Maes et al. (2004), that installing a stepping stones system of suitable habitat patches is the most efficient way to restore a healthy metapopulation structure, which surely works much better than ‘generalistic ’corridors in enhancing the conservation status of many invertebrates.

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