YEARLY PROJECT REPORT – No.2

2023



Dear olive farmers and stakeholders participating and interested in our project ECO-OLIVES!

We thank you very much for your kind collaboration and support! With this report we want to give you an overview of what has been achieved in ECO-OLIVES since 2022.

This report gives an insight into the first results of our project. The scientific analyses are still in progress and will continue throughout the next year - but we can already provide some very interesting updates with you that we find exciting to share and discuss.

We are very happy to provide you with some updates and first results from the project.
Major highlights and information from the last two project years include:

- **New students and team members** joined us in 2023
- **Farms and Trees** were measured in detail, together with continued and new data recordings
- **Arthropods:** At least 3800 recorded species, belonging to 25 different orders and 217 families (including at least 32 species of ants and 121 species of spiders - with one new record for Italy!)
- **Birds:** 59 bird species observed (including 39 insectivorous species)
- **Bats:** 25 bat species recorded (out of 27 species in Italy - all insectivorous)
- **Plants**: 205 plant species were documented (out of 28 botanical orders and 50 families)
- **Harvest:** Successful completion of the second harvesting season (192 trees individually)
- **Experiments:** Successful start of COMPASS pruning and end of exclusion experiments
- **Analyses:** First analyses of data and observed trends which are presented here
- **News and Upcoming:** Several new partnerships, project plans, and funding applications contributed to the continuation, expansion and success of our project and collaborations

Please find details on all these project highlights in the following Yearly Report and do not hesitate to contact us for further mutual exchange on our project and collaborations.

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STUDY DESIGN AND AIMS OF ECO-OLIVES

In ECO-OLIVES, we link biodiversity data of birds, bats, and arthropods (insects and spiders) to olive management and production data. We focus on functionally important species groups that provide ecosystem services such as biological pest control (e.g., suppression of pest insects like olive fly and olive moth), as well as dis-services (e.g., effects of olive fly and olive moth on olive yield quantity and quality). Specifically, we study the occurrence of different bird, bat, and arthropod species in relation to local farm factors (e.g., composition and condition of olive trees and local vegetation), landscape factors (e.g., proximity to and amount of surrounding natural and urban habitats) and local management (e.g., COMPASS/pruning effects) over the year, also accounting for effects of seasons (e.g., migration of species) to better understand:

- **The importance of local, landscape and seasonal factors for species conservation**
  (Why do certain species occur in some places and times and not in others?)
- **The multi-trophic interactions of species**
  (Which species promote or counteract the occurrence of other species?)
- **The effects of species on olive production**
  (How is the occurrence of species related to olive yield quantity and quality?)

Based on a statistically optimized study design that ensures high data power through the selected number and characteristics of farms, as well as through the biodiversity surveys and their replications, we aim to better understand the interactions of biodiversity, olive management and production. The recorded data and considerations of different management techniques will help us to better understand how biodiversity, management and production can be combined sustainably – which means how environmental, societal and economic considerations can be harmonized in the management of the olive growing landscape that depends on ecosystem services.

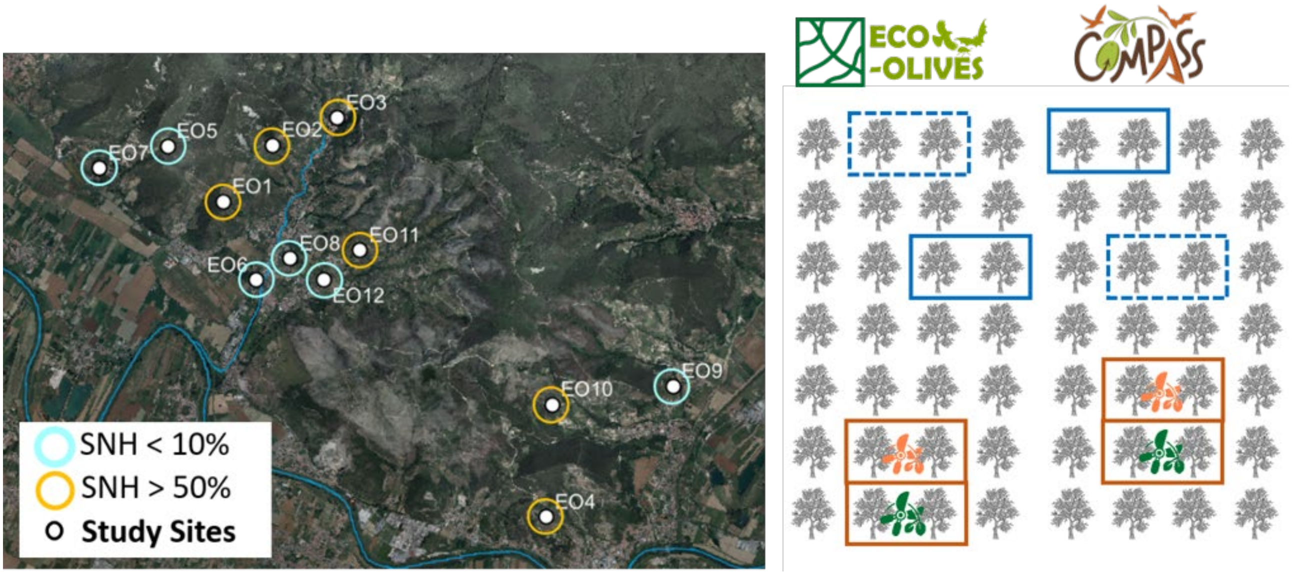


Figure 1: Study design of ECO-OLIVES and COMPASS. On a landscape scale (left), we compare 12 organic olive farms in Monte Pisano – 6 of which are surrounded by a high amount of semi-natural habitat (>50% within 500m radius; orange circles) and 6 of which are surrounded by a low amount of semi-natural habitat (<10% within 500m radius; blue circles). On a local scale (right), we compare 16 olive trees per farm, including four unmanipulated control trees and four bird and bat exclusions per farm (= ECO-OLIVES; 2022 and 2023), as well as each four trees pruned in February or April (= COMPASS; 2023 until 2025).

BIODIVERSITY DATA RECORDED IN 2022 and 2023

Birds, bats, and arthropods have a high functional diversity which means they have a high variety of feeding guilds and habitats in which they occur, as well as a high mobility. Depending on the availability of local resources (such as the local plant diversity) and the structure of the landscape, insect eating birds, bats, and arthropods (like ants and spiders) can reduce the amount and impact of different insects (including many pest insects) and thereby contribute to the ecosystem service of natural pest control. To investigate these ecosystem services, we observed and recorded birds, bats, arthropods, and the vegetation in all the project sites using these methods:

Birds: Visual and acoustic point counts; Capture-release surveys including fecal sampling; Acoustic recording
Bats: Acoustic ultrasound recording with specialized ultrasound recorders; Capture-release survey trials
Arthropods: Canopy fogging and genetic analyses; Pitfall traps in the ground; Visual observations on trees; Honey traps on olive tree branches (to study ants on trees); Winkler traps (to study ants on ground)
Vegetation: all the plant species present within six elongated 4 m2 grids in each farm were documented. The grids were positioned under tree canopies, in the center of the farms, and along the farm edges.

BIRDS

Birds play a crucial role in providing ecosystem services by suppressing pests, dispersing seeds, aiding in pollination, and maintaining overall ecosystem health. There are more than 10,000 species of birds worldwide, occurring in all types of habitats and within different functional groups. Italy harbors a total of 572 bird species. However, the alarming decline in both species' numbers and the associated ecosystem services they provide has emerged as a pressing concern for ecosystem resilience. The primary driver of this decline is the rapid expansion and intensification of agricultural landscapes. For instance, bird populations across Europe have declined by 25% in 40 years. In agricultural environments, birds have already declined by 60%, and this number continues to rise. About half of the bird species found in Europe feed primarily on insects, but their functions are compromised by their decline. The populations of birds that feed mainly on insects have decreased on average by 13% between 1990 and 2015 in the European Union.

We study birds with three distinct methods: Point counts, capture-release surveys, and acoustic recordings.

1. Systematic point counts

Systematic point counts served as a foundational method for documenting bird species within the study area. At a fixed location on each farm, we recorded all birds seen or heard for a total of 10 minutes. Point counts were repeated three times in each spring and autumn 2022 and 2023.

During the period between April/May 2022 and September/October 2023, we observed a total of 59 bird species, encompassing 3871 individuals (see Table 1). Our findings revealed seasonal variations in both the richness and abundance of bird species. Notably, we identified more species during spring (1925 individuals), while we recorded more individuals in autumn (1946 individuals, Figures 2 and 3). This could be attributed to the migration of many bird species to their winter habitats. In addition to these seasonal distinctions, we observed differences in bird abundance between the two years, with higher numbers noted in 2023 (1990 individuals) compared to 2022 (1881 individuals, Figure 3). Among the species, *Sturnus vulgaris* (474 observations), *Erithacus rubecula* (307 observations), and *Parus major* (289 observations) were the most frequently encountered across all project sites (see Table 1).

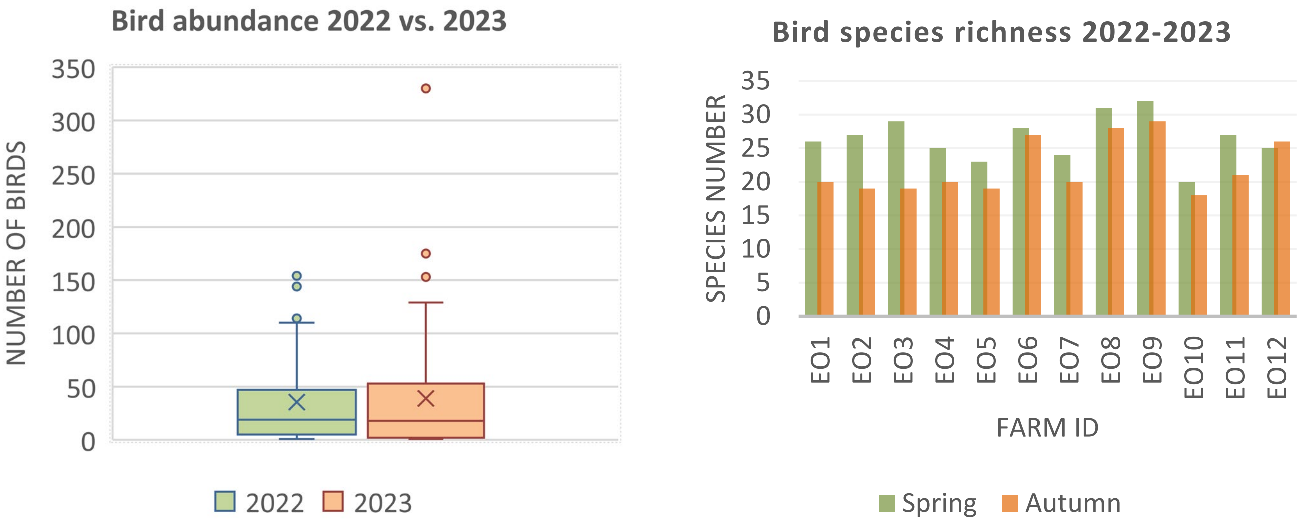


Figure 2: Annual and seasonal differences in bird abundance and species richness based on point counts.

Table 1: List of bird species and numbers detected in 12 olive farms of the ECO-OLIVES project.

Diet		Species name (**English**, *Scientific*, Italian)	E01	E02	E03	E04	E05	E06	E07	E08	E09	E10	E11	E12	TOTAL per species
Chiefly insectivorous		**Barn Swallow** *Hirundo rustica* Rondine			8	1		18	10	4	3			5	**49**
		**Cetti's Warber** *Cettia cetti* Usignolo di fiume								1					**1**
		**Coal Tit** *Periparus ater* Cincia mora								1					**1**
		**Common Chiffchaff** *Phylloscopus collybita* Luì piccolo	1	4		2	1	2	6	1	1	1	3	2	**24**

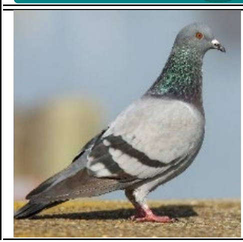
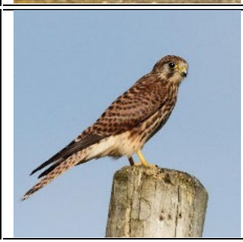
	**Common Cuckoo** *Cuculus canorus* Cuculo		3	1							4	3	2	**13**
	**Common Firecrest** *Regulus ignicapilla* Fiorrancino	8	1	10		8	8	2	4	2	1	5		**49**
	**Common Hoopoe** *Upupa epops* Upupa	1	2	1	3		2	3	3	4	1	1	2	**23**
	**Common Nightingale** *Luscinia megarhynchos* Usignolo						1		7	6		5	10	**29**
	**Common Redstart** *Phoenicurus phoenicurus* Codirosso comune	4	5	8	7	1	1	2	1	3	5	5	2	**44**
	**Common Stonechat** *Saxicola torquatus* Saltimpalo								3				2	**5**
	**Common Swift** *Apus apus* Rondone Coman				2			2		2	32		10	**48**
	**Dunnock** *Prunella modularis* Passera scopaiola		1		1					1	1		1	**5**

	**Eurasian Blackbird** *Turdus merula* Merlo	12	16	24	16	17	21	17	20	14	19	13	20	**209**
	**Eurasian Blackcap** *Sylvia atricapilla* Capinera	17	23	32	20	20	29	20	35	28	13	14	23	**274**
	**Eurasian Blue Tit** *Cyanistes caeruleus* Cinciarella	10	12	9	6	15	10	10	4	19	11	16	5	**127**
	**Eurasian Golden Oriole** *Oriolus oriolus* Rigogolo	1			1					2		2		**6**
	**Eurasian Green Woodpecker** *Picus viridis* Picchio verde	9	12	10	16	11	7	5	15	15	9	21	7	**137**
	**Eurasian Hobby** *Falco subbuteo* Lodolaio									1				1
	**Eurasian Wryneck** *Jynx torquilla* Torcicollo						1							1
	**European Bee-eater** *Merops apiaster* Gruccione				2									**2**

	**European Honey-buzzard** *Pernis apivorus* Falco pecchiaiolo		1											**1**
	**European Robin** *Erithacus rubecula* Pettirosso	15	27	31	16	46	17	18	41	36	27	16	17	**307**
	**European Starling** *Sturnus vulgaris* Storno	20	49	15			172	56	71	8		21	62	**474**
	**Great Spotted Woodpecker** *Dendrocopos major* Picchio rosso maggiore	1			1	1			1	4	1			**9**
	**Great Tit** *Parus major* Cinciallegra	26	22	20	22	26	20	38	23	32	20	27	13	**289**
	**Grey Wagtail** *Motacilla cinerea* Ballerina gialla			1					1					**2**
	**Long-tailed Tit** *Aegithalos caudatus* Codibugnolo	3	1	11	14	16	4	20	4	9	4			**86**
	**Melodious Warbler** *Hippolais polyglotta* Canapino comune									1			1	**2**

	**Northern House Martin** *Delichon urbicum* Balestruccio	9	53		25		15		7	3	3	1		**116**
	**Northern Wren** *Troglodytes troglodytes* Scricciolo		1	2	1	4				5				**13**
	**Red-backed Shrike** *Lanius collurio* Averla piccola	1										2		3
	**Red-billed Leiothrix** *Leiothrix lutea* Usignolo del Giappone	3	24	22	4	36	1		5	9	15			**119**
	**Sardinian Warbler** *Sylvia melanocephala* Occhiocotto	25	26	5	6	26	7	10	19	15	30	34	3	**206**
	**Short-toed Treecreeper** *Certhia brachydactyla* Rampichino comune	7	4	8	9	9	2	4	5	6	2	3	2	**61**
	**Song Thrush** *Turdus philomelos* Tordo bottaccio	2		1		1	3			1	1	1	1	11
	**Spotted Flycatcher** *Muscicapa striata* Pigliamosche			2		3	2							**7**

		**Western Cattle Egret** *Bubulcus ibis* Airone guardabuoi						1							**1**
		**White Wagtail** *Motacilla alba* Ballerina bianca			4			1	4	4	3			5	**21**
		**Zitting Cisticola** *Cisticola juncidis* Beccamoschino							1						**1**
Chiefly granivorous		**Cirl Bunting** *Emberiza cirlus* Zigolo nero		7	2				2				1		**12**
		**Common Chaffinch** *Fringilla coelebs* Fringuello	11	8	1	3	3	7		3	3	4	2	6	**51**
		**Common Woodpigeon** *Columba palumbus* Colombaccio		4	11	11	7	5	8	4		4	4		**58**
		**Common Pheasant** *Phasianus colchicus* Fagiano comune									2	1	2		**5**
		**Eurasian Collared-dove** *Streptopelia decaocto* Tortora dal collare	6		5		4	14	9	18	17		11	17	**101**

		**Eurasian Tree Sparrow** *Passer montanus* Passera mattugia								1				2	3
		**European Goldfinch** *Carduelis carduelis* Cardellino	1	1	1	2		4	2	1	2		3	5	**22**
		**European Greenfinch** *Chloris chloris* Verdone	2					6		3	2		5	16	**34**
		**European Serin** *Serinus serinus* Verzellino	7	5	9	12	1	20	12	4	8	1	6	11	**96**
		**European Turtle-dove** *Streptopelia turtur* Tortora selvatica		8	1		3	1	7	2	2	5	2	3	**34**
		**Italian Sparrow** *Passer italiae* Passera d'Italia		8	32	1		13	47	25	15		12	51	**204**
		**Rock Dove** *Columba livia* Piccione domestico	5	2	10	2	1	11	2	7	17		1	4	**62**
Carnivorous		**Common Kestrel** *Falco tinnunculus* Gheppio	3	1	1	2		1		1			2	1	**12**

		**Eurasian Buzzard** *Buteo buteo* Poiana		2			1	1			1			1	**6**
		**Great White Egret** *Ardea alba* Airone bianco maggiore						1	1						**2**
		**Little Owl** *Athene noctua* Civetta								1			1		**2**
Omnivorous		**Carrion Crow** *Corvus corone* Cornacchia grigia	15	9	17	15	1	6	21	20	21	10	9	8	**152**
		**Eurasian Jackdaw** *Corvus monedula* Taccola	6					22	1	12	10			3	**54**
		**Eurasian Jay** *Garrulus glandarius* Ghiandaia		4		2	7				3	3			**19**
		**Eurasian Magpie** *Pica pica* Gazza	12	12	18	19	8	8	11	17	12	11	25	12	**165**
Total per field			**243**	**358**	**333**	**244**	**277**	**465**	**351**	**399**	**348**	**239**	**279**	**335**	**3871**

2. Scientific capture-release surveys and fecal sampling

During our surveys in spring and autumn 2023, birds were captured and released following high scientific standards, allowing for detailed assessments of their physical characteristics, behaviors, and health. Further, we extracted DNA samples from the birds to study bird dietary habits. The primary focus is on understanding how insect-eating species contribute to the important ecological service of pest suppression.

In 2023, we conducted capture-release surveys, capturing a total of 436 individual birds, including 22 re-captures, representing 31 different species in both April/May and October/November 2023 (Figure 3). Our observations revealed seasonal variations in bird species composition, with 26 species identified in spring and 18 in autumn (Figure 4). Notably, despite fewer survey rounds in autumn (one compared to two in spring), bird numbers are anticipated to be higher during this season.

Our reveal a tendency towards higher abundance of birds in urban project sites compared to areas surrounded by a high proportion of semi-natural habitats (Figure 5). This pattern might be explained by various factors. One hypothesis is that urban environments offer abundant resources like food and suitable nesting sites, making them favorable for certain bird species. The presence of diverse anthropogenic structures in urban areas can also serve as suitable habitats for some birds. Additionally, altered landscape and environmental conditions in urban settings may create specific niches for particular bird populations.

To deepen our understanding, we are complementing these observations with DNA analyses of 301 fecal samples. This integrated approach aims to unravel the dietary preferences of birds across seasons, contributing to our comprehension of their ecological role in pest suppression services.

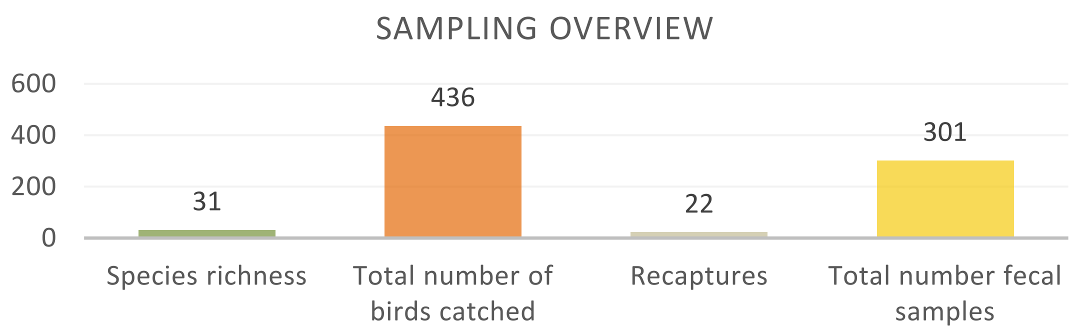


Figure 3: Overview of capture-release surveys in spring and autumn 2023.

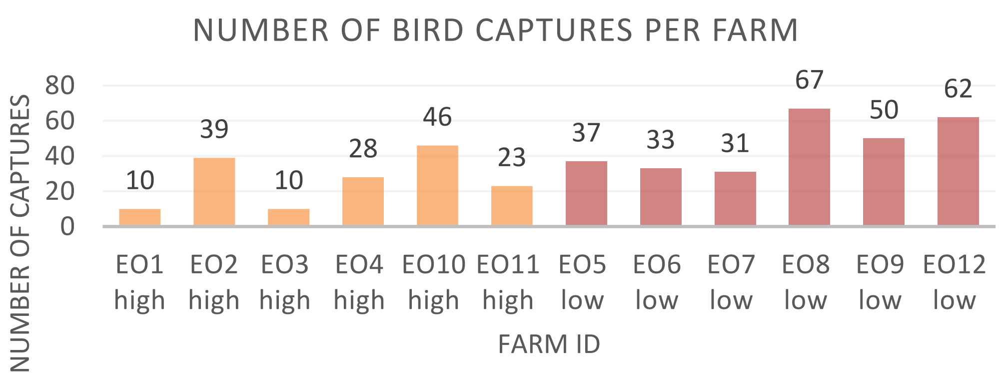


Figure 4: Total number of individual birds captures per farm during capture-release surveys in 2023. Farms are subdivided in high (green) and low (orange) proportions of surrounding semi-natural habitats (SNH).

3. Acoustic recordings

By capturing and analyzing the sounds produced by birds in the period between 2023 and 2024, we will gain insights into their vocalizations, enabling identification of species even when visual confirmation is challenging. This approach enhances our ability to comprehensively understand the avian composition in our study area. We have completed 8 acoustic surveys per farm in spring and autumn 2023.

BATS

Bats are highly mobile and active in providing crucial ecosystem services such as biological pest control, seed dispersal, pollination, and nutrient cycling. About one-third of the approximately 1,400 known bat species worldwide are listed as endangered or are understudied for classification. Due to their nightly activity, their contribution to ecosystem services such as biological pest control is often underestimated.

Insectivorous bats typically eat insects amounts that make up about one-third of their own body weight. This equates to up to ten grams per night. In the summer months, this can even amount to up to one kilogram of insect food. However, eating bugs, which is not only helpful for reducing mosquitoes and other insects at bay for us humans, also has economic importance. Scientific studies on the economic value of bats to agriculture estimated that bats provided natural pest-control services totaling $3.7 billion to $53 billion per year. This study did not even consider what the indirect costs of “replacing” bats with pesticides would be in terms of potential health and pollution threats from greater levels of toxins in the environment.

In Italy, there are 27 different bat species that are all "insectivorous", which means they feed on insects and potentially contribute to natural pest control also in agricultural habitats. However, agricultural expansion and intensification is also the main threat to bats and is causing a steady decline of species and individual numbers. In particular, the decline of suitable foraging habitats and roosts is posing a great threat to this species group and associated ecosystem services.

In 2022 and 2023, we recorded 25 bat species on the 12 project farms – all of them being insectivore and thereby potentially contributing to biological pest control. We have pre-analyzed 8500 hours of bat recordings, processed and pre-identified by automatic classifiers (Auto-ID), meaning with the help of computer software, resulting in a total of 28,853 bat passes (=5 second duration file with minimum 2 calls per species). By analyzing and comparing the available data, we can expect that these recordings represent at least 21 different bat species, which is a very positive and surprising result for us.
However, since we used these Auto-ID data for this preliminary report, for some species (marked with*) we can only confirm their occurrence after manual post validation. Since we can hardly see bats due to their night time activity, we have measured their activity by their call signals to give you a picture of their activity on the 12 project sites (EO1-EO12). The most common species in our survey areas was the Nathusius pipistrelle (Pipistrello di Nathusius), which might be a commonly found bat, but still very functional in providing pest control. In addition, we found 16 species of conservation concern: seven species are classified as “near threatened” (NT), five species as “vulnerable” (VU), three species as “endangered” (EN) and one species is classified as “critically endangered” (CR) by the IUCN Red List of Italy (see Table 2 for more information).

Table 2: List of bat species and numbers detected in 12 olive farms of the ECO-OLIVES project. Detections are based on automatic identification of bat species compared with other large data sets of bat sounds (processed in Kaleidoscope Pro software). Bat species of conservation concern category (IUCN - Red List Italy) are highlighted and indicated with: NT (“near threatened”, green) VU (“vulnerable”, yellow), EN (“endangered”, orange) and CR (“critically endangered”, red).

Species name **(English,** *Scientific,* Italian)	EO 1	EO 2	EO 3	EO 4	EO 5	EO 6	EO 7	EO 8	EO 9	EO 10	EO 11	EO 12	TOTAL per species
Western barbastelle* EN *Barbarstella Barbastellus* Barbastello	3	4	1	8	4	2	7	0	0	15	1	10	**55**
Northern bat *Eptesicus nilssonii* Serotino di Nilsson	1	1	5	21	4	2	18	1	2	53	2	5	**115**
Common serotine NT *Eptesicus serotinus* Serotino Comune	2	2	1	4	2	0	1	0	4	4	0	0	**20**
Savi´s pipistrelle *Hypsugo savii* Pipistrello di Savi	176	128	213	205	373	124	85	62	145	100	329	548	**2488**
Common bent-wing bat *Miniopterus schreibersii* Miniottero comune VU	19	27	216	9	291	21	263	8	4	7	1	8	**874**
Bechstein's bat* EN *Myotis bechsteinii* Vespertilio di Bechstein	0	0	1	0	1	1	0	0	0	1	0	0	**4**
Brandts myotis *Myotis brandtii* Vespertilio di Brandt	0	0	4	1	0	2	1	0	0	0	0	2	**10**
Dauberton's myotis *Myotis daubentonii* Vespertilio di Daubenton	0	6	4	22	46	4	21	2	4	21	3	3	**136**
Geoffroys myotis* NT *Myotis emarginatus* Vespertilio smarginato	0	0	0	0	1	0	0	0	0	0	3	0	**4**
Mouse-eared myotis* VU *Myotis myotis* Vespertilio maggiore	0	0	0	0	0	0	2	0	0	0	1	0	**3**
Natters myotis* VU *Myotis nattereri* Vespertilio di Natterer	0	1	1	2	0	0	0	0	1	0	0	0	**5**

Grater noctule bat CR *Nyctalus lasiopterus* Nottola gigante	0	4	2	14	4	8	6	1	11	4	20	43	**117**
Lesser noctule NT *Nyctalus leisleri* Nottola minore	7	2	14	4	7	8	15	2	4	13	3	8	**87**
Common noctule VU *Nyctalus noctula* Nottola comune	0	8	23	62	9	14	7	7	28	51	8	27	**244**
Kuhls pipistrelle *Pipistrellus kuhlii* Pipistrello albolimbato	90	404	107	302	650	215	353	78	141	141	164	1058	**3703**
Nathusius pipistrelle NT *Pipistrellus nathusii* Pipistrello di Nathusius	255	629	319	389	1696	510	278	280	459	184	499	4357	**9855**
Common pipistrelle *Pipistrellus pipistrellus* Pipistrello comune	18	35	32	37	152	54	111	37	12	86	16	172	**762**
Soprano pipistrelle *Pipistrellus pygmaeus* Pipistrello pigmeo	8	3	18	6	44	6	12	1	1	19	7	10	**135**
Brown long-eared bat NT *Plecotus auritus* Orecchione comune	0	1	1	2	1	0	3	2	1	1	1	0	**13**
Grey long-eared bat NT *Plecotus austriacus* Orecchione meridionale	2	1	4	1	18	3	12	3	9	6	7	2	**68**
Mediterranean horseshoe bat NT *Rhinolophus euryale* Ferro di cavallo euriale	0	3	0	0	0	3	11	0	2	0	0	1	**20**
Greater horseshoe bat VU *Rhinolophus ferrumequinum* Ferro di cavallo maggiore	8	6	16	0	9	17	58	7	26	7	16	415	**585**
Lesser horseshoe bat EN *Rhinolophus hipposideros* Ferro di cavallo minore	12	50	85	96	203	107	127	102	177	216	736	397	**2308**

European free-tailed bat *Tadarida teniotis* Molosso di Cestoni	474	226	43	373	98	188	830	120	885	372	379	1052	**5040**
Particoloured bat* *Vespertilio murinus* Serotino bicolore	0	2	3	10	1	2	0	1	0	17	0	1	**37**
TOTAL per field	1075	1543	1113	1568	3614	1291	2221	714	1916	1318	2196	8119	**26,688**

We observed interesting patterns in the bat activity and diversity across the seasons and habitats (Figure 5). One of the key findings was that we recorded a total higher bat activity in autumn (October and November) compared to spring (April and May), which might be related to the availability of food resources and the hibernation behavior of bats. For example, one finding was that *Rhinolophus sp.* (a genus of bats of high conservation concern), showed a dominance of activity in early spring, indicating that they may wake up from hibernation earlier than other species. Furthermore, we found a general dominance of edge space foraging in olive farms, which might be explained by the higher insect abundance and diversity along the edges of the fields. Finally, we noticed that the activity and species composition in the semi-natural control site were significantly lower than in the farms, suggesting that the olive farms provide a suitable habitat for bats.

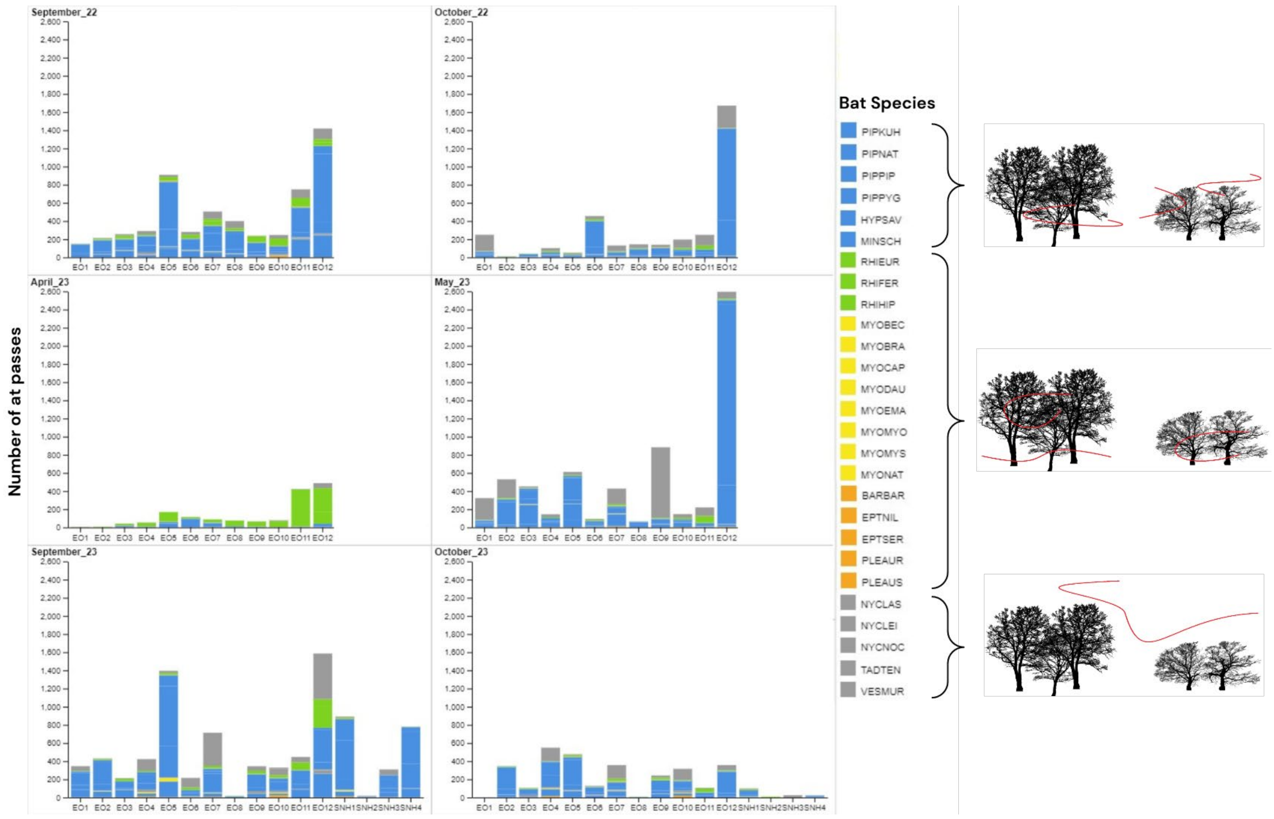


Figure 5: Total Number of bat passes (2022-2023) per season and month (September and October; April and May) on each farm (EO1-EO12). Color code indicating the foraging/feeding guild of the recorded bat species, categorized by flight pattern (like in the pictures on the right).

We studied how the local climate of farms affects the activity and variety of bats at night. We found that temperature has a big impact on bat activity, but rainfall does not (see map of Figure 6). This is expected because bats are mammals and hibernate during winter. Some farms had more stable climates and more bat activity than others, suggesting that local climate can affect bat activity (see visualization of bat activity per farm and temperature in Figure 6). However, we need to look more closely at different bat species to understand how they react to changes in temperature. This will help us see how changes in the environment might affect bats and their use of olive groves as places to find food in hot and cold months. For example, we found that bats were active when temperatures were between 7.42 and 25.17 degrees per night. Interestingly, the *Rhinolophus ferrumquinium* bat, which is a species we are concerned about protecting, seemed to tolerate different temperatures more than the common Nathusius pipistrelle bat, which needed temperatures above 8.3 degrees. This suggests that some bat species might be better able to adapt to future climate changes and continue to provide important services to the ecosystem. We are planning to do more research in the winter to learn about the temperature preferences of different bat species and how they use olive groves as a source of food in the winter.

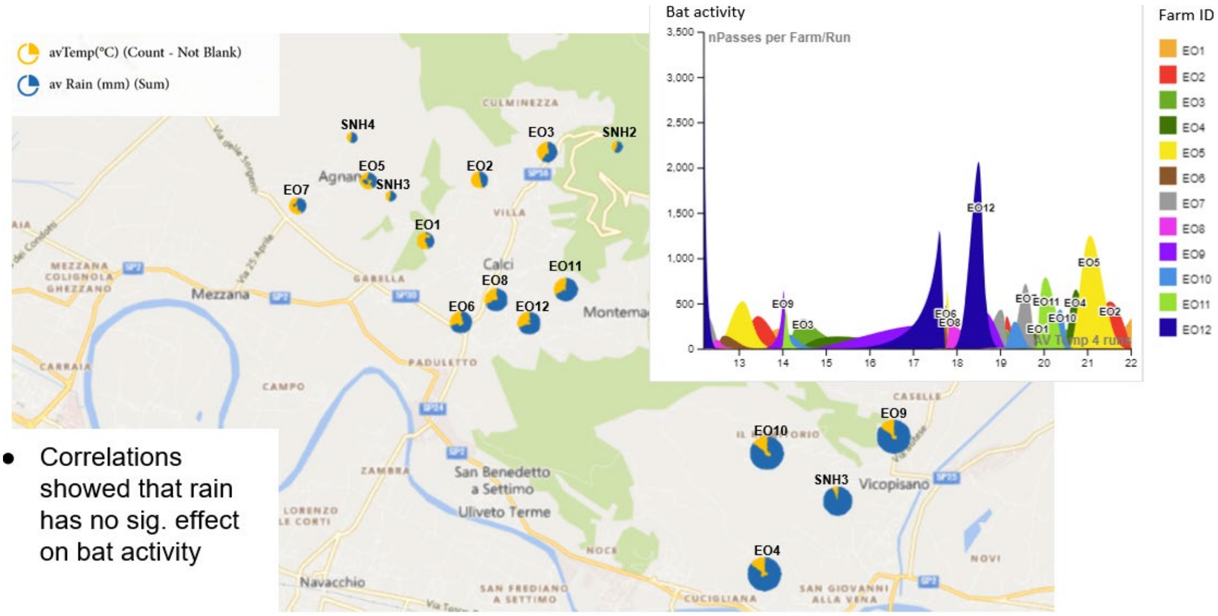


Figure 6: The map shows the nightly average rainfall and temperature per farm on recording days. Rainfall had a negative effect on bat activity, temperature has a positive effect in most sampling months. The graph shows the relationships between average nightly temperature per farm and overall bat activity.

ARTHROPODS

Terrestrial arthropods are a megadiverse group, comprising at least 85% of animal life forms: more than a million species of insects (just insects, not arthropods in general!) have been described, and it has been estimated that these correspond to about 10% of the actual total. This diversity and this complexity reflect upon ecosystem services provided by arthropods: in fact, some of them are primary production consumers, feeding on vegetation, but others (like ants and spiders) are intermediate-level predators, called meso-predators. The meso-predators act as biological pest control agents, feeding on herbivorous insects, thus helping to prevent pest demographic explosions. In turn, most arthropods are preyed upon by vertebrates such as birds and bats and present one of their most important food resources.

Around 99% of arthropod species provide functions that are only neutral or even highly beneficial to us, for example yield-promoting pollination or pest control in agricultural systems. The economic value of the sole pollination service has been estimated around 153 billion dollars. High diversity of arthropods, which is mostly related to high diversity of plants, supports more diverse ecological and agricultural systems that are more resilient to pests and other challenges (such as extreme weather events) than less diverse systems, because higher biodiversity provides a natural buffer against disturbances. For these reasons, it is essential to protect arthropods biodiversity (and biodiversity in general) at its finest, especially in these years when factors such as intensive agriculture and climate change are threatening most arthropod species.

During 2022 and 2023, we have recorded more than 3800 species of arthropods, belonging to 25 orders and 117 families. To reach this result, we used an integrated approach during our samplings, combining three different trap types (Pitfall traps, Honey traps and Winkler traps) with other approaches like visual observations and canopy fogging. This approach allowed us to study the arthropod diversity at every ecosystem level of our olive groves, from the first portion of the soil to the canopies of the trees.

Visual observations

Visual observations served as a fundamental method for counting and documenting the arthropod fauna living on olive trees. A single tree observation lasted 10 minutes, and both the canopy and the trunk of the tree were carefully inspected. During the two years of samplings, we reported 209 genera of arthropods, belonging to 133 different families and 25 different orders. In general, the surveys carried out during Spring highlighted a higher diversity than the ones carried out in Autumn. Among the different orders, spiders (Araneae) were by far the most abundant arthropods, followed by Hymenoptera and Diptera (Figure 7).

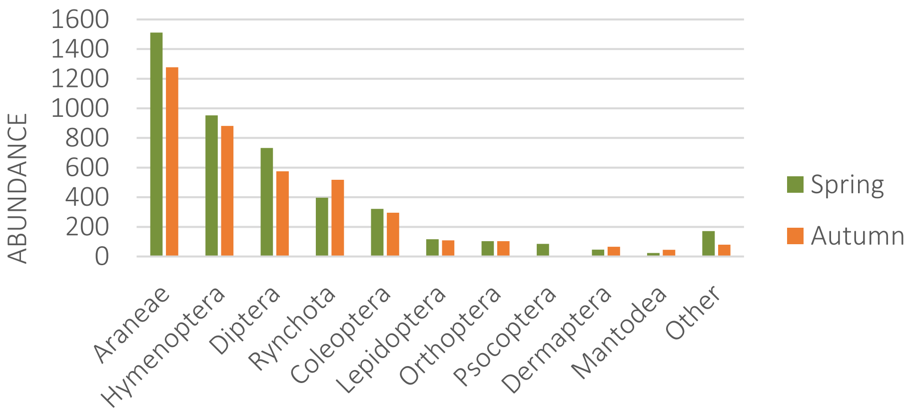


Figure 7: Seasonal differences in the abundance of the main arthropod orders found during visual observations surveys of 2022 and 2023.

Figure 8: Seasonal differences in arthropod abundance per site (visual observations of 2022 and 2023).

We started the observations in 2022, taking data on eight trees per farm, three times (one in spring and two in autumn). Four of these eight trees had their canopy wrapped up in a net that did not allow birds and bats to access the internal portion of the tree (exclusion experiments). The main aims of this sub-project were observing the changings in the arthropod communities simulating a massive decrease in their main predators, and comparing these data with the ones from the four unmanipulated control trees (Figure 9; left side).

In 2023 we added 8 COMPASS trees per farm, increasing the total number to sixteen, and we took these data five times (three in spring and two in autumn). Four of these COMPASS trees were pruned in February, and the other four were pruned in April: once again, the aim of the subproject was the comparison of the arthropod communities in these two tree categories (Figure 9, right side).

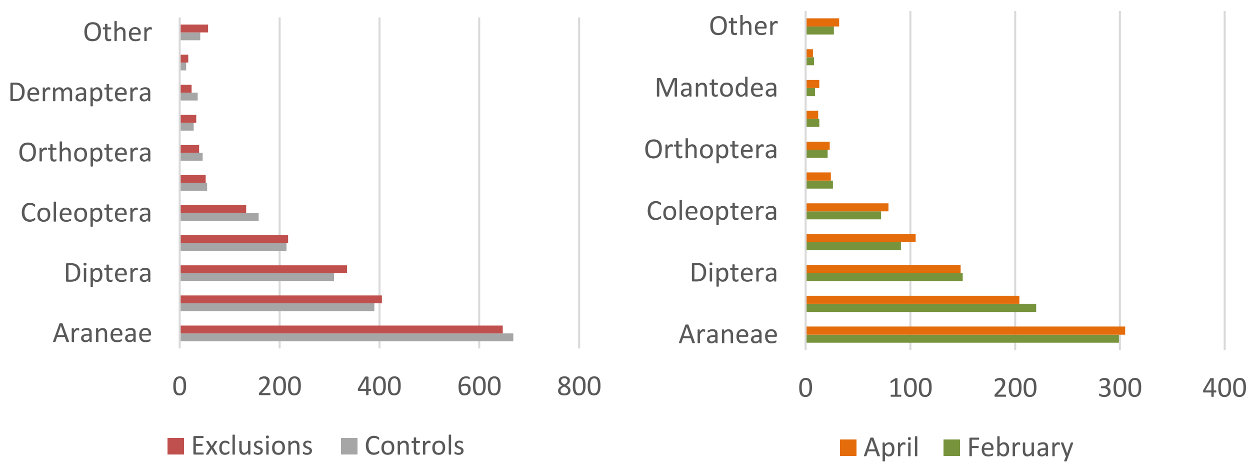


Figure 9: Differences in arthropod abundance in experimental treatments (exclusions of birds and bats; and pruned COMPASS trees).

Traps

During the eight runs of surveys performed in 2022 and 2023, we placed 672 traps in our twelve olive farms. Out of the total, 75 traps were destroyed or empty, and the remaining 597 were successful. To study arthropod biodiversity as accurate as possible, we used three different types of traps: Pitfall traps (targeting ground arthropods); Honey traps (targeting tree arthropods); and Winkler traps (targeting soil arthropods).

1) Pitfall traps

Pitfall traps are used to study ground-dwelling arthropods. Per farm, we used four traps (glasses) buried in the ground and covered by a black PVC roof, and we kept them in the field for one week per survey. During the laboratory identification of the arthropods found inside the pitfalls, we concentrated on spiders: we reported 74 species of ground-dwelling spiders, belonging to 23 different families.

Table 3: List of selected spider families (more than 1 observed individual) and number of specimens detected per farm. Spiders were identified by examining the genitalia under a stereomicroscope.

Arthropod Family	EO1	EO2	EO3	EO4	EO5	EO6	EO7	EO8	EO9	EO10	EO11	EO12	Total
Agelenidae			2										**2**
Dysderidae	1	5	1	3		1	5	12		1	2		**31**
Gnaphosidae	3	6	13	17	1	17	4	11	6	7	8	21	**114**
Hahniidae			5					1				1	**7**
Linyphiidae	1	1	10	2	14	14	4	3	1	5	8	7	**70**
Liocranidae				1		1			2			3	**7**
Lycosidae	12	15	11	12	17	10	28	29	34	18	33	26	**245**
Nemesiidae	1	1	1			1							**4**
Philodromidae					1				2			1	**4**
Phrurolitidae			13	1		2		2				4	**22**
Salticidae	3	3	7	4	5	10	5	10	2	7	3	3	**62**
Scytodidae	9	7	5	13	3		10	9	1	7	8	1	**73**
Tetragnathidae			1				1						**2**
Theridiidae		2	1		2	1	2	1	4		1	1	**15**
Thomisidae	9	26	13	9	12	5	11	8	5	11	10	2	**121**
Titanoecidae								1	1			6	**8**
Zodariidae			4			9	1	4			1		**19**
Total	**39**	**67**	**88**	**64**	**55**	**71**	**71**	**91**	**59**	**56**	**74**	**77**	**812**

2) Honey traps and Winkler traps

These traps were used to study ants. Ants are highly active and impactful organisms that provide relevant ecosystem services by defending their colonized trees and trophobionts (aphids and cicada they keep for harvesting honey dew) from other arthropods. Winkler traps are white cotton bag constructions used to filter arthropods from a litter sample taken around the study trees. Honey traps are little sample tubes including a mixture of honey and rum that attracts ants, but also other insects such as beetles and flies. Our partners in Florence are currently providing great support to our project, sorting and identifying the ants taken from these sticky samples, which is a very challenging task.

Canopy fogging

The canopy fogging technique was performed once (May 2022), inside ten of our twelve olive groves. Eight trees per farm were sampled. This method was fundamental to gain information on the arthropod community living inside olive tree canopies. This sampling method is noninvasive as it is using Pyrethrum, a natural gas harmless to the environment that dissolves after a few minutes. However, it is sufficiently effective to make insects and spiders fall on the ground for some minutes, enabling biologists to collect them.

The canopy fogging samples were preserved in 99% alcohol, and subsequently sent to a qualified laboratory at Würzburg University, where metabarcoding analyses were performed. Out of the 1862 sent individuals, 1105 were identified to the family, 601 to the genus, and 319 to the species level. Spiders were preliminary morphologically identified under the stereomicroscope (Table 4). The Araneidae family was by far the most abundant one, followed by Theridiidae and Thomisidae.

Table 4: List of selected spider families (more than 5 observed individual) and number of specimens detected per farm. Spiders were identified by examining the genitalia under a stereomicroscope.

Spider Family	EO1	EO2	EO3	EO4	EO5	EO6	EO9	EO10	EO11	EO12	Total
Araneidae	11	25	4	25	5	21	29	45	17	41	**223**
Cheiracanthiidae		2		2	3	1				1	**9**
Clubionidae		2		1	1	4	3	10	2	8	**31**
Dictynidae	2	4	1	2		10	18	9	5	14	**65**
Gnaphosidae					1		1	10	2		**14**
Linyphiidae	2	1	1		3	1	2	1	9	4	**24**
Philodromidae		5	1	2		23	14		2	17	**64**
Salticidae		1			3	5	1	1	1	2	**14**
Segestriidae		1		3					2		**6**
Theridiidae	1	2	1	2	1	20	16	9	9	13	**74**
Thomisidae	1	1	1	1		6	4	3	9	47	**73**
Total	**19**	**45**	**10**	**38**	**18**	**91**	**90**	**90**	**58**	**148**	**607**

While identifying the canopy fogging samples from our site EO11 from 2022, we found a spider that has not been reported for Italy before (new species observation!). Its name is *Phaeocedus vankeeri*, and it belongs to the Gnaphosidae family, a huge spider family that includes 169 species from 31 genera just in Italy. The specimen we found is an adult male of 4.5mm of body length, and the analysis of the pedipalps (the second pair of appendages) allowed us to be sure about the species. *Phaeocedus vankeeri* was first described only in 2019, and it is officially known for Greece, France, and Corse: considering its Mediterranean distribution and its recent description, the presence of this species in Italy is not very surprising, but still of great value. In the precedent records, this spider was found on the ground, while our specimen was found in the canopy of an olive tree. Other findings, both on the trees or on the ground, could help to better understand the almost unknown ecology of this species.

Figure 10: Stereomiscroscope picture of *Phaeocedus vankeeri*

VEGETATION

Plants play very important roles in maintaining the equilibrium of ecosystems. As primary energy producers, they sustain higher trophic levels, offer shelter and sustenance to animals, and regulate the flow of essential nutrients throughout the ecosystem. Thus, richness and abundance of vegetation in Agroecosystems may enhance the provision of ecosystem services.

Diversity on the vegetation cover in agricultural landscapes supports animal-mediated ecosystem services such as pest control by increasing the abundance and diversity of natural enemies of crop pests. This has the potential to mitigate crop damage maintaining crop yield and quality. Preserving plant diversity is important to maintain resilient agricultural systems, and in turn agricultural sites are key for the conservation of plant species, especially in the Mediterranean region that harbors approximately 25,000 plant species of which 60% are unique to the region, and has therefore been designated as a Biodiversity Hotspot. Traditional Mediterranean Agroforestry ecosystems, like olive groves, contribute significantly to biodiversity conservation given its potential as refugia.

During the vegetation assessments in October 2023, 1561 individual plant specimens belonging to 205 different species were documented across the 12 farms of the ECO-OLIVES project. The most represented botanical families were Poaceae, Asteraceae, Fabaceae, Plantaginaceae, and Apiaceae, with over 80 specimens across the farms (Table 5). In each farm at least 50 different plant species were registered (Figure 11); this number will most likely increase during the next vegetation assessment in spring 2024. From the reported species 78% have been identified to the genera or species level, and 22% have been identified to the family level, and the identification work continues.

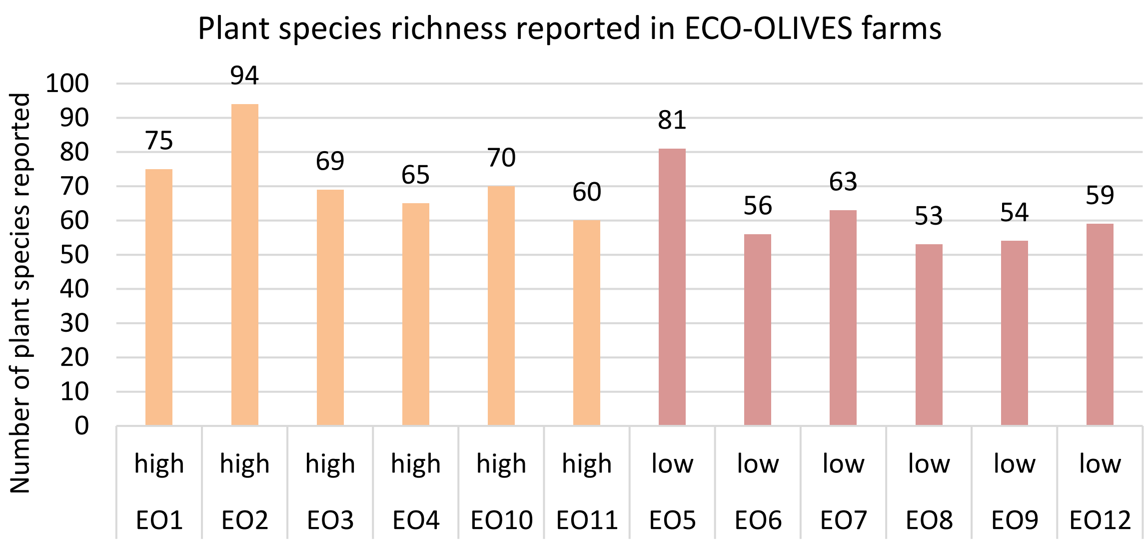


Figure 11. Plant species richness per project farm. Number of plant species reported per each ECO-OLIVES farm, organized according to the amount of semi-natural habitat surrounding the farms. High amount of surrounding semi-natural habitat corresponds to >50% within 500m radius, and low amount of surrounding semi-natural habitat corresponds to <10% within 500m radius.

A higher plant abundance was reported on farm edges compared to centers of the farms and under the tree canopies (Figure 12) emphasizing the edges' importance in safeguarding biodiversity and drawing diversity towards the olive groves. Farms surrounded by a higher percentage of semi-natural habitat harbored, on average, 10 more plant species, suggesting an influence of complexity of the surrounding habitats on the plant communities in the ECO-OLIVES farms. This diversity highlights that farming ecosystems are complex systems, and the distribution found through the data collection can give us insights into ecological processes in the farms, and provide us with an idea on how to better conserve biodiversity in olive Agroecosystems.

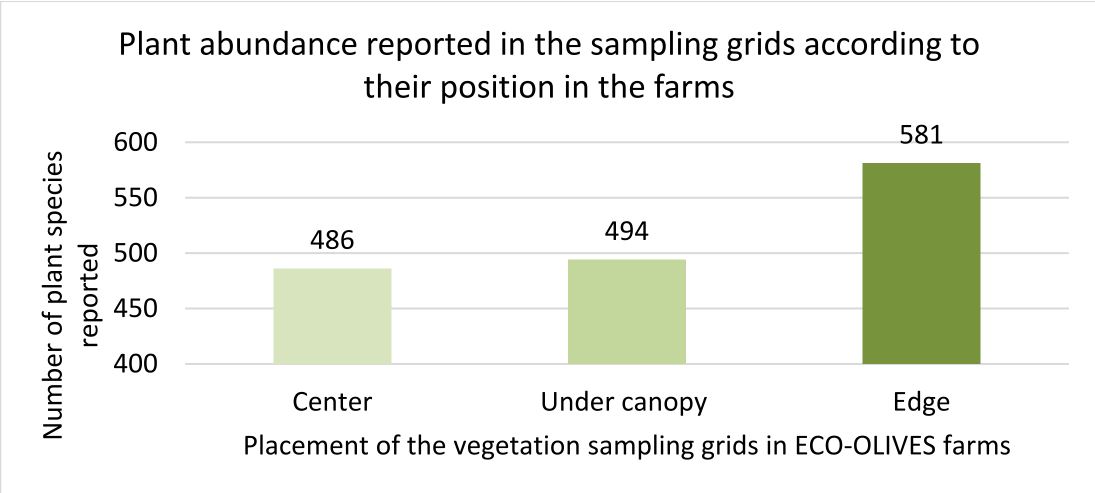


Figure 12. Plant abundance registered in various locations within ECO-OLIVES farms. The vegetation assessment encompassed central farm areas, under tree canopies, and along farm edges.

Table 5. List of selected plant botanical families (more than one observed individual), together with their abundance. Marked with (*) the most abundant families with more than 80 plant reports across the farms.

Botanical families	**EO1**	**EO2**	**EO3**	**EO4**	**EO5**	**EO6**	**EO7**	**EO8**	**EO9**	**EO10**	**EO11**	**EO12**	**Total**
Amaranthaceae				2	1			1	2		2		**8**
Apiaceae*	6	7	4	7	8	5	11	4	6	10	5	8	**81**
Araceae	2	3	1		5						3		**14**
Araliaceae	1	1			2		1		1	1			**7**
Asparagaceae	3	2		4	4	1	2		2	3	1		**22**
Asteraceae*	27	37	26	13	29	27	22	41	19	20	35	24	**320**
Brassicaceae	2	5		2	1	1	1					3	**15**
Caryophyllaceae	6	7	5	1	8	4	6		1	4	4		**46**
Cistaceae	2				2								**4**
Convolvulaceae		2	5	2		2	4	4	6			6	**31**
Crassulaceae	2	2			4						6		**14**
Cyperaceae		3	2	1		5	2	2	3	3	6	3	**30**

Ericaceae					4					1			**5**
Euphorbiaceae		1	1		1								**3**
Fabaceae*	6	17	8	14	15	3	8	9	6	12	5	4	**107**
Fagaceae		2			1				1	1			**5**
Gentianaceae								1				2	**3**
Geraniaceae		1	4		3	2	1	6	2		2	4	**25**
Hypericaceae		6	1	6	3		1			2		1	**20**
Lamiaceae*	3	7	4	2	5	6	1			5	3	1	**37**
Linaceae	1		2			1		2		2	1		**9**
Malvaceae		1		1	1	1	1						**5**
Myrtaceae	1				2								**3**
Oleaceae	2	1						1	2	2		1	**9**
Orchidaceae	1	1	1			1							**4**
Oxalidaceae	1	5	2	2	5	5	5	4	1	5	6	1	**42**
Plantaginaceae*	12	8	8	14	4	6	9	6	2	7	7	11	**94**
Poaceae*	35	35	25	40	21	27	22	27	34	33	21	22	**342**
Polygonaceae	2	7	7	3	6	5	6	5	3	4	2	2	**52**
Portulacaceae	1										2	2	**5**
Primulaceae	1		1	1	2	1		2		3	2		**13**
Ranunculaceae	6	5	2		6	3	7	1		1	1	2	**34**
Rosaceae	4	6	5		6	3	7		5	8	2	4	**50**
Rubiaceae	2	5	4	1	3	4	5		1	1	1	3	**30**
Santalaceae				3							1		**4**
Scrophulariaceae		1		2		1	1						**5**
Smilacaceae					1	1					1		**3**
Solanaceae		1	1	1	4				1	1	2		**11**
Verbenaceae			1						1			1	**3**
Total records per farm	**134**	**184**	**123**	**126**	**159**	**120**	**129**	**119**	**100**	**134**	**123**	**110**	**1561**

HARVEST DATA

We collected harvest data for all our individual project trees in autumn 2022 and 2023 (total of 192 trees: 96 trees of ECO-OLIVES and 96 trees of COMPASS, which were included in January 2023). In addition to the total weight of olives harvested per tree, we also determined the respective proportion of "healthy" and "infested" olives per tree. In addition, the degree of ripeness of the olives, the variety of each tree and the length and width measurements of ten randomly selected olives were recorded.

Comparing the harvest data of 2022 and 2023 (Table 6) only is sensible for the unmanipulated control trees in our project since all experimental trees were of course affected by our treatments (see updates on bird and bat exclusion experiments and COMPASS below). Although considering all project trees in a more complex analyses provides more stable and reliable data statistically, comparing the mean harvest (in g) and pest infestation rates (in%) of the control trees shows a general trend of decreased harvest quantity in 2023 than in 2022, but also that this decrease seems not be only related to increased pest infestation rates.

The exclusion nets were removed from all trees as part of the harvest in 2023 (see updates below).

Table 6: Overview of harvest data (only control trees!) of ECO-OLIVES in 2022 versus 2023

Farm ID	Mean g/tree 2022	Mean g/tree 2023	Diff: 23-22	Mean % "infested" 2022	Mean % "infested" 2023	Diff: 23-22
EO1	2774	3330	556	52	33	-19
EO2	2848	5654	2806	25	59	34
EO3	504	2513	2009	27	40	14
EO4	1951	520	-1431	31	22	-9
EO5	3472	3158	-314	37	31	-5
EO6	4906	409	-4497	23	45	22
EO7	1950	1705	-245	25	15	-10
EO8	4309	5398	1088	22	31	9
EO9	1456	2949	1493	49	17	-32
EO10	2938	1058	-1880	33	27	-6
EO11	5737	123	-5614	41	38	-3
EO12	6673	3659	-3014	17	29	11

EXCLUSION EXPERIMENTS & COMPASS PRUNING

In the ECO-OLIVES project, we study the interactions of biodiversity and olive production with many different approaches to find holistic and applicable solutions for harmonizing the management of both. Our studies include experimental approaches to study the impacts and potentials of biodiversity and local farm management to enhance pest control services and thereby increase harvest quantity and quality sustainably. In ECO-OLIVES, we excluded birds and bats at each four trees of each of the 12 project farms to simulate how their decline (which is unfortunately ongoing) will affect pest control and harvest and thus find scientific evidence for their improved conservation and management. We added the COMPASS project to our approach (with eight additional trees per farm) to also study the effects of systematic tree pruning on ecosystem services and olive production. We study the biodiversity of birds, bats, and arthropods on all 16 study trees per farm and compare the effects of experimental exclusions and pruning against unmanipulated control trees to detect the difference between “business as usual” (control trees) and all other trees.

For COMPASS, we selected eight additional olive trees on our 12 project farms that are pruned in February and April (each one group of four trees per farm). In February 2023, we initiated the COMPASS project to study the effects on systematic tree pruning on biodiversity and ecosystem services of arthropods. We believe that improved knowledge about the interactions of tree pruning and biodiversity-related effects on the farm can help us to find ways to better combine and implement biodiversity-friendly olive management and production. Targeted optimization of pruning practices is difficult due to various local and landscape factors, as well as due to the time-lags in responses of biodiversity and production. Since olive tree pruning is intended to optimize the structural composition of trees over a long-term, our according study is planned for a minimum of three years.

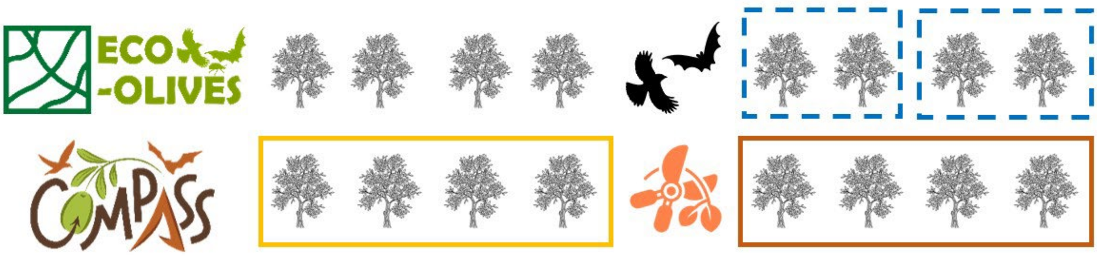
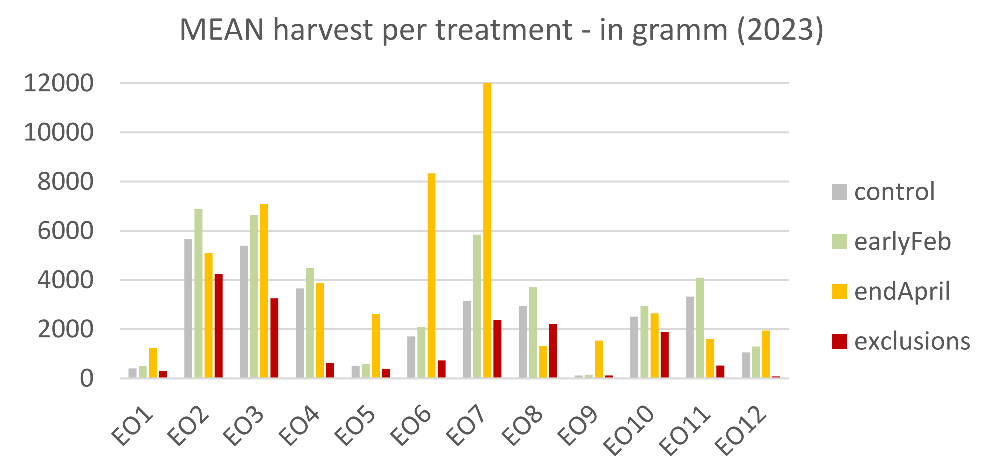


Figure 13. Our study design on each of the 12 project farms includes 8 study trees of ECO-OLIVES (four unmanipulated controls and four exclusions of birds and bats) as well as 8 study trees of COMPASS (two groups of each four neighbor trees pruned in February or April, respectively).

Our approach to olive tree pruning and studying its effects and potential for sustainable olive cultivation will span over multiple years (at least until 2025). We prioritize on mitigating the impact of tools on the trees, as well as on creating a delicate balance that not only enhances sustainable olive production through traditional management and pruning techniques but also aligns with the imperative of biodiversity conservation and the overall management of ecosystem services. By observing the evolving climate conditions, we strive to harmonize human-agriculture interactions, with a strong emphasis on prioritizing the safety and well-being of local workers and other stakeholders facing the increasingly pressing challenges of climate change and biodiversity decline. This approach not only fosters a more sustainable and resilient olive production system but also establishes a foundation for building trust and synergy between humans and agriculture, thereby promoting a holistic and environmentally conscious approach to olive cultivation.

The first findings on bird and bat exclusion experiments and COMPASS, resulting from our first joint analysis of all project trees per farm, already show very interesting effects of both approaches on harvest quantity and quality (Figures 14 and 15). While we need further data and analyses to perform fully reliable analyses with sufficient data over sufficient time periods, these first insights already show a very promising trend:

1) Our harvest data show that exclusion of birds and bats (simulated absence of birds and bats) leads to decreased yields due to increased pest infestation rates, providing strong evidence for increasing conservation efforts for birds and bats that feed on insects. The effects of COMPASS (February and April pruning) lead to the opposite effect: increased yields and decreased pest infestation rates (Figure 14).



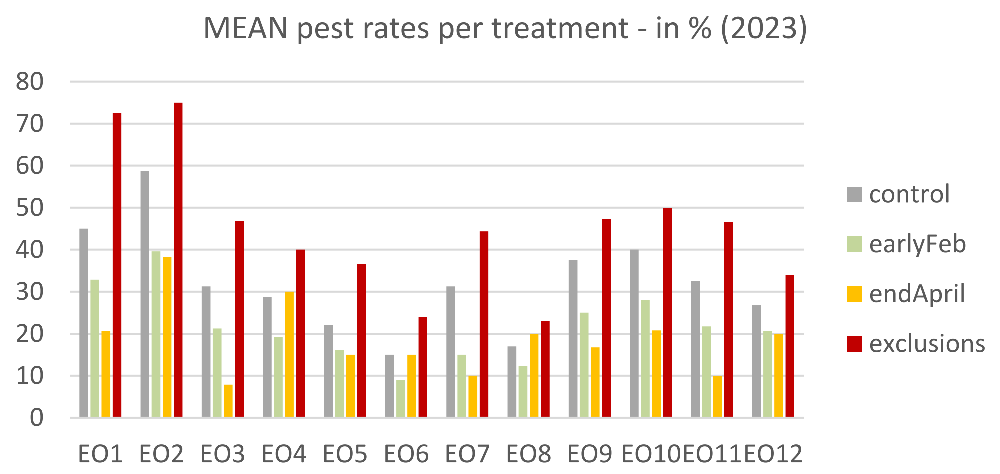


Figure 14: The upper graph shows treatment effects on olive harvest (in grams) and the lower graph shows treatment effects on pest infestation rates (in %) – both for 2023. Both graphs show results for all 12 farms in our project (always groups of 4 bars showing effects on control trees in grey; exclusion effects in red; and COMPASS effects in green/February and orange/April).

2) Our arthropod data show a clear and direct response of different arthropod groups to the systematic pruning treatments of COMPASS. Comparing the abundance of arthropods observed at unmanipulated control trees ("business as usual") and pruned trees (COMPASS) from the spring data in 2023, we see that numbers of arthropods such as flies and cicada, providing dis-services associated to the olive fly or disease transfer, decreased on pruned trees (Figure 15). On the other hand, beneficial arthropods groups such as spiders and ants, providing ecosystem services such as pest suppression, increased on the pruned trees. Other arthropod groups showed a less strong response in spring 2023 but may show a stronger response in the autumn data and/or after longer application of the pruning treatments at our study trees – which needs further data evaluation and studying to find out.

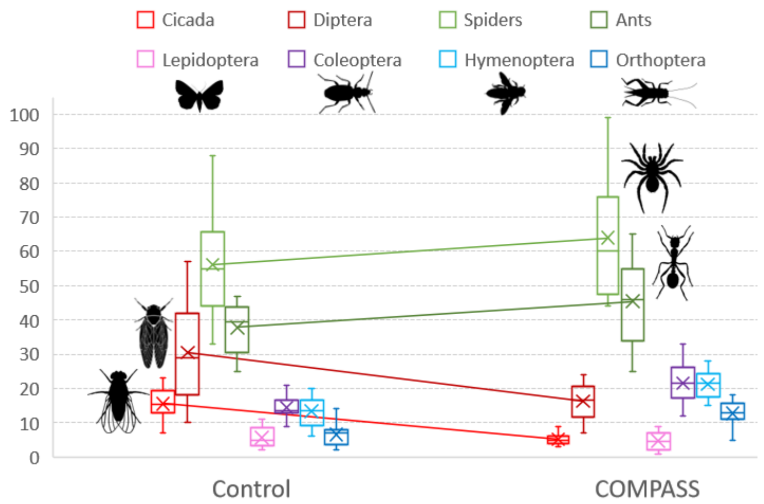


Figure 15: COMPASS pruning effects on arthropod abundance.



Altogether, our project connects ecological research with the needs of society. Our results will contribute to a more sustainable management of and conservation of biodiversity in Mediterranean olive farming areas and beyond. By combining scientific rigor, involving stakeholders, and focusing on practical solutions, we aim to not only contribute to academic knowledge but also to have a real impact on policies, conservation strategies, and farming practices. This comprehensive approach aims to have lasting positive changes to ecological systems and the communities that depend on them.

On a long term, our projects aim to advance understanding, improved management, and implementation of environmental, social, and economic sustainability (the three main pillars of sustainability). The following graph shows how we want to specifically contribute improved knowledge (first row of outcomes), advanced management approaches (second row), and more effective implementation of this evidence and practical developments into agricultural policies (third row) across all three sustainability pillars.

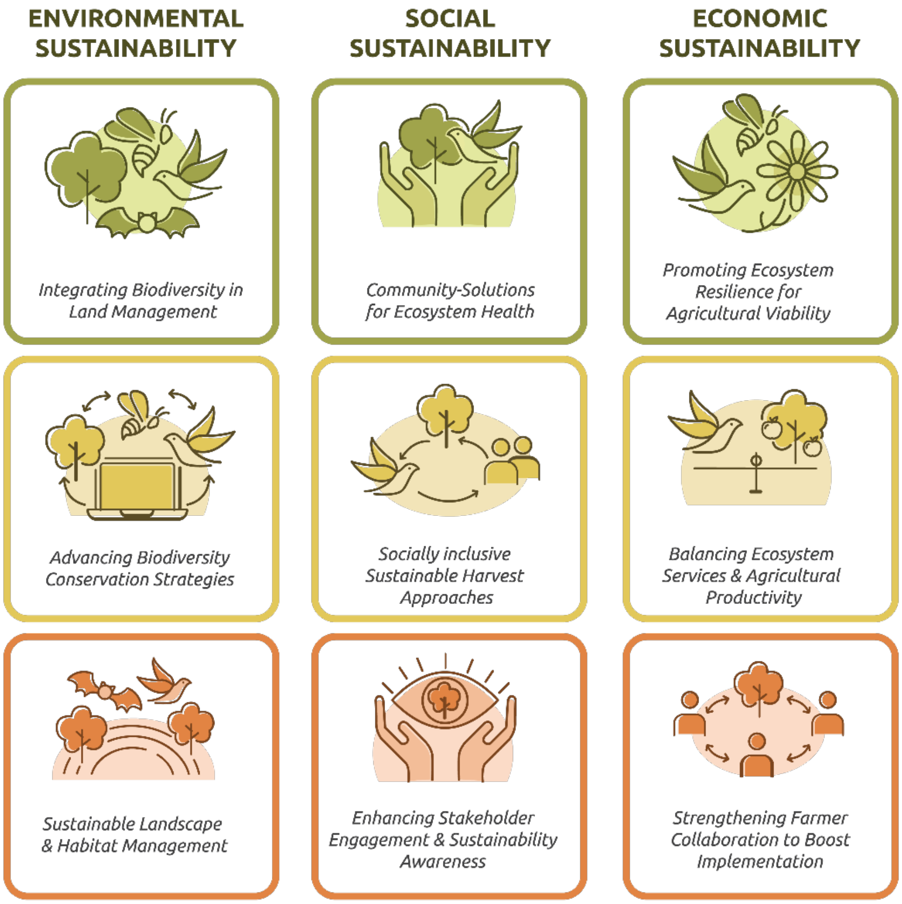


Figure 16: Interdisciplinary approach for transformative sustainability strategies.

Sustainability is a big deal for consumers nowadays. People care more and more about the environment, social issues, and the quality of the food they eat. This is especially important when it comes to extra virgin olive oil. Besides its high value for Mediterranean ecology and economy, it exhibits a nuanced relationship with biodiversity and ecosystem services. These factors are not just nice extras – they are used to market the oil and make sure consumers keep choosing it. However, figuring out exactly what makes something sustainable can be complex. It depends on many factors such as the size of the company, where it is located, the technology it uses, and the rules in that area. There is a lot to consider, like traditions and local culture, involving many different people and in the process. Looking ahead, making, and following policies about sustainability should involve sharing information between different groups of all involved stakeholders.

In order to achieve our project goals, we want to develop and expand our studies and collaborations accordingly. In addition to the expansion of projects to develop stable data sets, this also requires the expansion of interdisciplinary collaborations and further studies on the complex interrelationship between environment, society, and agriculture. In the last section of this report, we describe our most important plans for the coming field seasons and welcome any feedback and mutual exchange on them.

UPCOMING IN 2023 and 2024

As in 2022, the first field research year of ECO-OLIVES, we were able to win four additional grants for our project this year, which provide deeper access to our research and implementation strategies. Among other things, these grants will allow us to expand our science communication and collaborations with international students, which will include the following activities in 2024:

During December 2023, we will finalize our study on winter bat activity, focusing on the role of olive groves as a food reservoir under climate change and changes in hibernation behavior of bats. This primarily includes studies at landscape level to record hibernation sites and microhabitats of bats such as caves and caveats.

From January 2024 onwards, our team will be busy with data analyses and writing of first manuscripts and further funding applications that are already under development. Among other things, this includes the development of a Europe-wide olive research network involving renowned partners and research-stakeholder-policy networks from olive-growing regions in Italy, Portugal, Greece, and Spain. In addition, next year we will be conducting several trips abroad for our tropical partner projects in Indonesia and Peru, which will focus on cocoa cultivation and place our agroforestry systems research in a global context (for example, to demonstrate the general potential for agroforestry systems from a local and landscape perspective).

In February 2024, we will continue our work on the COMPASS project and prepare for another field season in which we will focus primarily on completing our data sets to create a more solid knowledge base.

In April and May 2024, we will start catching and releasing bats in the ECO-OLIVES farms to collect fecal samples and determine the health of the bats feeding in our olive groves. At the same time, we will continue our last season of sound recordings to assess the activity. We will also carry out a final evaluation of the microhabitat mapping to identify suitable potential roosting habitats for bats in the olive groves.

During the upcoming spring season 2014, we will also continue exploring the interactions between plant diversity and arthropod, bird, and bat communities. We aim to assess the potential of farm vegetation in enhancing pest control and further investigate ecosystem services linked to plant diversity

Through these final field research activities of ECO-OLIVES in 2024, we aim to continue to foster international expertise and collaboration in our projects, thereby creating a comprehensive dataset that will support a robust analysis of all project questions and the **continuation of COMPASS (at least until 2025)**.

We will continue to keep you and our project partners, as well as other interested target groups, up to date on the progress of the project. Among other things, we will participate in numerous scientific conferences, policy, and networking meetings in 2024 to ensure the continuation of our research and project goals. We will keep you informed about our project results beyond the field research phase and will offer interactive, participatory workshops in our study area again to promote our mutual exchange.

Our previous reports provide further details on our approaches and projects in relation to research activities, data analysis and collaborations. In 2024, we will also launch an international stakeholder survey in collaboration with our international network (see Acknowledgements).

ACKNOWLEDGEMENTS

We sincerely thank all project partners for their support of ECO-OLIVES!

First and foremost, we thank the owners and managers of the twelve olive groves in our project, as well as our partners at the University of Sant Anna, especially Camilla Moonen, for their tireless support in all phases of the project.

We are very grateful to our partners at the Universities of Sant Anna, Florence, Vienna, Würzburg and Berlin, and to our international scientific-practical network for their support at all levels - from ant identification to large-scale genetic analyses in an always inspiring exchange.

In 2024, we will launch an international olive stakeholder survey to assess regional and international perspectives of different olive production and management interest groups to better understand how the harmonization of biodiversity conservation and sustainable olive farming can be better designed and implemented. Our implications for improved implementation approaches will be based on the results of our mutual exchange, interviews, and app-developments in both the study area and in close cooperation with several, international project partners of ECO-OLIVES, including the wide networks of:

OLIVARES VIVOS – based in Spain (www.olivaresvivos.com)
CIBIO – based in Portugal (https://cibio.up.pt/en/)
BESLab – based in Spain (https://beslab.net/)
AnEcoEvo Lan – based in Italy (http://www.ecoap.unina.it/)
BioEcoLab – based in Greece (http://bioecolab-aegean.blogspot.com)

More information about our projects and collaborations will be available on our project website from the start of 2024 - including some video insights from 2022 and 2023:

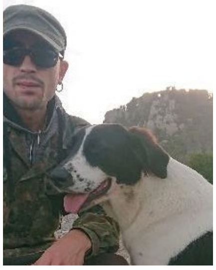
https://www.beamaas.com/projects.html

INFOS ABOUT OUR TEAM & CONTACTS

The ECO-OLIVES team continued to grow over the last two years - both in ambition and in size! Thanks to a great team spirit and great motivation of everyone involved, we were not only able to accomplish everything we set out to do, but also to expand our research scope and collaborations. We sincerely thank all those who supported our team during this time and look forward to the upcoming endeavors and further exchange with all those involved and interested!


Bea


Virginia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The whole team of ECO-OLIVES is wishing you wonderful holidays and is looking forward to starting the next field season starting in February/March 2024!