



LIFE *Orchids*

# Wild Orchid Stewardship

Good practices for conservation in meadows,  
vineyards, olive groves, hazel groves and gardens

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Project co-financed by the European Union LIFE Programme



LIFEorchids LIFE17 NAT/IT/000596  
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The guidelines provided in this handbook summarize agronomic techniques and expedients actually used by farmers and enthusiasts.

We are therefore deeply and sincerely grateful to those who made the drafting of this handbook possible, i.e. to **all the Orchid Stewards** who have shared their experiences with us:

Andrea Allavena, Claudio Amerio, Demis Bassan, Fabio Benvenuto, Francesco Biscia, Jacopo Calevo, Matteo Chialva, Carla Demagistri, Davide Germiniasi, Paolo Rizzola, Rosella Rocchetti, Giovanni Scaglione, Anita Siffredi, Marco Testa, Gianfranco Torelli, and to all those **who directly or indirectly have shared information, suggestions and observations**.

**Special thanks** to Mariangela Girlanda and Giovanna Garrone (Department of Life Sciences and Systems Biology, University of Turin) for **sharing ideas** and providing support during interviews and the drafting of texts.



This Handbook is dedicated to all **Land Stewards**:

professional farmers, who steadfastly work their land while respecting nature, following its rhythms and timings;

amateur and passionate farmers, who cultivate with enthusiasm not only the earth, but also the landscape that surrounds us.

Recognition goes to them for preserving an enviable heritage, often hidden, which deserves to be known by all.

# Preface

## LIFEorchids and Orchids Stewardship

The idea of this handbook originated within the context of the *LIFEorchids project – Improving the conservation status of critically endangered orchid communities in selected habitats in northwestern Italy* (LIFE17 NAT/IT/000596, www.lifeorchids.eu), co-funded by the LIFE programme of the European Union.

The aim of *LIFEorchids* (2018-2023) is the conservation of wild orchids typical of habitat 6210\* [Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (\*important orchid sites)], both through restoration and subsequent conservative management of the target habitat, and through approaches less common in Italy, such as the (re)introduction of orchid plants deriving from *in vitro* germination and the stipulation of Land Stewardship Agreements. In particular, one of the concrete conservation actions develops the Land Stewardship approach, aiming to build a network of “Orchid Stewards” who manage their lands (whether they are productive plots or not) in a sustainable way and in balance with the needs of these fascinating species, which are real “flags” of biodiversity.

Among the communication and dissemination activities of the project, one is specifically devoted to the training of Stewards, both already involved and prospective, through seminars and meetings. In this framework the idea arose of bringing together, in a small, dedicated publication, the indications, collected also through a process of consultation with landowners, for an “orchid-friendly” land management.

Lands with different use were considered, such as gardens and uncultivated meadows, but also, and with particular interest, vineyards, olive groves and hazel groves. The Land Stewardship approach is in fact associated with a concept of biodiversity conservation based on the creation of integrated agro-ecosystems, that allow widespread conservation throughout the land, going beyond natural parks and protected areas.

The drafting of the manual was entrusted to our colleagues the agronomists Davide Barberis, Giampiero Lombardi and Michele Lonati (Department of Agricultural, Forestry and Food Sciences of the University of Turin), who also drew on the experience of the project *LIFE Xero-grazing-Semi – natural dry-grassland conservation and restoration in Valle Susa through grazing management* (LIFE12 NAT/IT/000818), developed between 2013 and 2019.

Within LIFEorchids, Land Stewardship activities are coordinated by Legambiente Lombardia, which is committed to promoting this approach (still in its infancy in the Italian context) since its involvement in the LANDLIFE project – *Boosting Land Stewardship as a Conservation Tool in the Western Mediterranean Arch: a Communication and Training Scheme* (LIFE10 INF/ES/000540, 2011-2014). Thanks to the participation of the Czech Union for Conservation of Nature (*Český svaz ochránců přírody, ČSOP*), the project also envisages an exchange of practices and knowledge with the Czech Republic, a country with a long tradition of involvement of individuals in nature conservation, and where the Land Stewardship approach is now well established, albeit in different forms from those proposed by LIFEorchids.

The response received by Orchid Stewardship activities over the lifespan of the project has been very positive, going even beyond the geographical scope of the project, revealing that in Italy, among the numerous orchid-loving people, quite a few are in tune with the values of Land Stewardship, and therefore willing to get directly involved through personal commitment. We join the authors in expressing to them all our gratitude and admiration.

**Giovanna Garrone**  
**e Mariangela Girlanda** (*University of Turin*)

## The central role of Land Stewards in nature conservation

This handbook is for Land Stewards wishing to preserve habitat 6210\*, which hosts the orchids protected by the *LIFEorchids* project. Italian wild orchids are terrestrial plants that live in different environments such as meadows, some pastures, near marshes or wetlands, forests and woods. *LIFEorchids* focuses in particular on the protection and conservation of those that are specific to habitat 6210\*, semi-natural dry grasslands and scrubland facies on calcareous substrate with remarkable orchid blooms.

Through Land Stewardship, landowners take an active role in the conservation of living species and in the enhancement of their own land through a public commitment relevant for the community. Engaging in Land Stewardship means taking care of life and biodiversity within habitats, and it implies realising the importance of one’s own positive action and participation. Stewards act with enthusiasm for the protection of soils and living species, as volunteers personally involved in the protection of nature as a common good.

We aim to support this passion so that the participation process can be fuelled by experience and by the knowledge of the secrets of these wonderful plants’ life. Understanding nature in fact allows us to behave in the best way to protect it, by preserving the diversity of living species. Diversity makes beauty - we are all aware of this when we observe a flowery meadow, a forest with different species of trees or a land cultivated by respecting all these gifts of Earth. Every living species establishes a relationship with its surrounding environment, and we can also say that it participates in determining that environment. With this handbook we mean to provide a practical tool that turns knowledge into action and allows to achieve the objectives of conservation and enhancement of wild orchids and their habitat.

The handbook provides some knowledge about the flowering period, the ecological needs, and

the characteristics of soils where orchids can live, but above all it illustrates the cultivation practices that can preserve the living conditions of these beautiful plants, which are also a good indicator of the health of the land.

Orchids’ biodiversity can coexist with the productive use of lands. The handbook shows which precautions and measures make this possible, demonstrating that these two objectives are not necessarily opposing.

Stewards using this handbook are requested to interact over time through feedback and comments which will allow to evaluate together the effectiveness of this tool for the preservation of wild orchids of habitat 6210\*.

The handbook is an approach of mutual partnership between stewards and the project, that requires sharing and exchange of information. We will steward orchids together and our life will be improved by preserving their existence around us.

**Simona Colombo e**  
**Marzio Marzorati** (*Legambiente Lombardia*)

## Land stewardship: the Czech Republic approach

Normally, in democratic societies, any intervention in the countryside can't be carried out without the cooperation of landowners, whether it's routine maintenance (like mowing or grazing), special targeted management for the benefit of certain species or, on the contrary, the prevention of some inappropriate activities and operations (building, ploughing, felling, excessive use of chemicals...).

Sometimes cooperation can be replaced by law enforcement, but the protection of nature and landscape conservation based on a position of power against the will of the landowner is always problematic as it can result in two conflict situations: court disputes assessing the legitimacy of property rights restrictions for reasons of public interest and illegal behaviour of the landowner who is more willing to pay a fine for breaching the law than to submit to it.

That is why there have long been different kinds of private initiatives for nature and landscape conservation related to the Land Stewardship approach all around the world.

Groups of people interested in nature and its protection contact owners of lands of natural interest and try to arrange some kind of cooperation with them, they take over the use and management of lands in the interest of nature conservation or they directly buy out these lands.

Associations that ease Land Stewardship are usually non-profit, non-governmental organisations.

In some countries this role is also carried out by foundations, municipalities or public administrations such as management bodies of protected areas.

In the territory of today's Czech Republic there is a long-standing tradition in this kind of approach. Leaving the first natural reserves aside, born from the will of landowners from the first half of the XIX century, the first targeted "association" leases and land purchases aimed at conservation

were documented in the early 1940s.

However, this promising trend was stopped by the advent of the communist regime that led to the dissolution of conservation associations and the suppression of property rights.

The tradition was resumed right after the fall of the communist regime, in the early 1990s.

The Czech Union for Nature Conservation (*Český svaz ochránců přírody, ČSOP*) gradually took the lead of the spontaneous efforts of a number of different entities in order to ensure the protection of valuable sites through lease agreements or buyouts.

Currently, there are approximately 70 land associations (*pozemkových spolků*) operating in the Czech Republic. These are non-profit organisations of different sizes: they have from three to dozens of members; some of them operate purely on a volunteering basis, others have temporary or permanent paid employees.

Some organisations take care of just one location, others manage dozens (sometimes hundreds) of locations across the country. Together, land associations of the Czech Republic currently manage more than 3,500 hectares of land. Just as there are diverse land associations, so are the plots under their care.

The most common lands are meadows of naturalistic value managed through mowing or grazing in order to preserve biodiversity.

Another large group of lands are wetlands where care is primarily focused on preserving or restoring the water regime, building ponds, or revitalizing waterways.

The third group consists of woods. Here the goals differ significantly according to the nature of the locality: some are managed with a minimum of interventions, essentially as wilderness, primeval forests; in others, on the contrary, active management supporting biological diversity and usually aiming at sparse, light forests is carried out.

The fourth habitat under the care of land associations is represented by old orchards which, with proper management, are extremely valuable areas in central Europe from a biological point of view, as they partially replace almost extinct woody steppes. These orchards exhibit the right conditions for many species of birds, mammals, insects and plants and they also represent an interesting gene bank of ancient varieties of traditional fruits. Orchids are frequently found in all these locations and the management is of course adapted to their needs.

As far as cooperation with landowners is concerned, the most common type in the Czech Republic is the taking over of the land management by a land association, i.e., the signing of a long term usage agreement.

The land is managed exclusively by the land association according to the rules of the agreement and the landowner is not directly involved in the management.

About a tenth of the managed areas are instead a direct property of land associations or of the Czech Union for Nature Conservation. Only in rare cases these lands were acquired through donation, mostly they were purchased at market prices.

The funding for purchases comes from projects like LIFE, contributions from corporate sponsors or donations from the public.

To date, contracts where the owners themselves take care of the land and the land association delivers help, service, for example professional supervision, practical help with some specific tasks or perhaps help with securing subsidies for care are rather marginal in the Czech Republic.

**Jan Moravec** (*Český svaz ochránců přírody, Czech union for the conservation of nature*)

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## Wild Orchids

**Orchids** are spread all over the world, and they reach their highest diversity of species in tropical areas, but they also live in temperate zones, and therefore in Italy. The Mediterranean area in particular features a great diversity of species, most of them **endemic**, i.e., they only live in a small area of our territory.

The **Orchidaceae** family, to which orchids belong to, is very complex, both in appearance and biology which depends on fragile ecological balances. Genetics is also highly variable, allowing for example the coexistence inside the same **species** of individuals that partly differ in appearance (often described as **subspecies**) and the creation of hybrids between different species.

Reproduction usually occurs thanks to **pollination** by specific categories of insects (see "Fun facts" box). In fact, every species of orchid has evolved through adaptation to a particular species (or group of species) of pollinators, without which reproduction could not be possible. The specific association between orchid and insect determined a complex **differentiation** of flower shapes between the different species which feature a magnificent variety of shapes and colours.

The most variable and noticeable characteristic of flowers is the **labellum**, the biggest petal which often features complex and beautiful patterns and that is the main reason for the great interest that both enthusiasts and naturalists have for these species. In agricultural environments, this close association between orchids and pollinating insects highlights, in comparison to other generalist pollinated species, how the presence of orchids is indicative of rich and diverse communities of insects, often in contrast with the environmental depletion caused by intensive agriculture (*Figure 1*). The specific associations with other living beings go beyond pollination.

and allowing it to do something it couldn't do on its own: absorb soil nutrients. Most orchids return the favour by giving the fungus part of the sugars created during **photosynthesis**.

Interactions with mycorrhizal fungi are therefore essential for the survival of orchids, affecting their spread (McCormick *et al.*, 2018). As a result, every agricultural practice that can alter the soil characteristics, from tillage to fertilisation, removal of the grass layer, etc. has a great impact on the fungal species present in the soil and consequently also on the presence of orchids (Cavallo *et al.*, 1993).

**Native orchids**, with few exceptions, are only visible during springtime, whilst during part of the year they persist underground in a state of vegetative dormancy.



*Figure 2.* At the beginning of the growing season, most orchids produce few leaves close to the ground (the so-called basal rosette).

In the few months when orchids produce leaves, usually condensed within a few centimetres from the ground (*Figure 2*), and then flowers, there is a great competition for light with other herbaceous plants, that's why the so-called "**heliophilous**" (i.e., sun-loving) orchids, usually prefer dry and low grasslands. These species living in meadows and pastures are

## Introduction

The aim of this handbook is to describe in detail the needs of **orchids** and the agricultural and management practices that can be implemented to **preserve them and ensure that they can propagate** in agricultural environments (meadows, vineyards, olive groves, hazel groves, etc.).

Thus orchids, thanks to their acknowledged role as **environmental indicators**, become the symbol of a **healthy and eco-friendly agriculture** that can generate high-quality products. This awareness should be shared by all actors on the land: professional and amateur farmers, consumers, and visitors.

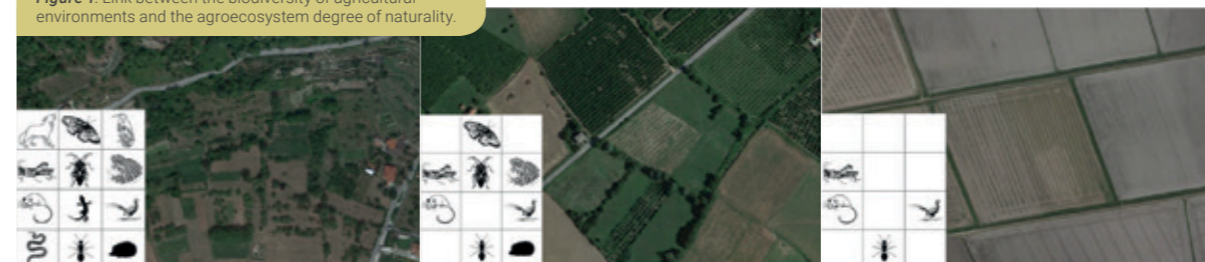
For decades now, we have been witnessing on the one hand the abandonment of non-mechanizable lands, on the other the agricultural intensification in the most accessible areas with a **great loss**, in both cases, of **biodiversity**.

Orchid populations have suffered a drastic fall following these socio-economic changes, that's why their conservation today is paramount. Their reliance on sustainable agronomic practices makes them ideally suited to this kind of conservation action.

Due to the extreme heterogeneity and diversification of the farms considered, this manual aims to be just a **starting point** to understand how every single agricultural context can represent a stronghold for **environment conservation**.

It was drafted based on a sample of farms of North-western Italy but, with the necessary changes, it could also apply to the rest of Italy or Europe, adjusting the good agricultural practices according to the species of orchids found in the different territories.

*Figure 1.* Link between the biodiversity of agricultural environments and the agroecosystem degree of naturalness.



In order to germinate, orchid seeds need to establish a **symbiosis** (i.e., a mutual collaboration relationship) in the soil with the hyphae of some fungi (mycorrhizal fungi) as seeds are very tiny, they lack nutrients and cannot germinate on their own. The **mycorrhizal symbiosis** continues even after germination, following the whole life cycle of the plant

precisely the ones of greatest interest, but they can also be found in croplands if the agricultural practices make it possible (Vukovic *et al.*, 2011). The manual deals primarily with heliophilous orchids of hilly areas, but there are also "**hemi-heliophilous**" (i.e., shade-tolerant) species typical of woods, others living in wetlands and species typical of alpine pastures.

# Orchid vulnerability and threats to their survival

The specific **associations of orchids with insects and soil fungi** make them particularly vulnerable to environmental changes, so much that many of them nowadays are considered at great **risk of extinction**. This happens because the loss of the fungus or the insect, to which the vegetative or reproductive cycle of the species are connected, determines the subsequent disappearance of the orchid itself. In the worst cases, there can be a total **alteration of ecosystems**, both due to their destruction, as in the case of woods and wetlands, and their abandonment, as for meadows (Vogt-Schilb *et al.*, 2015).

To date, the major cause of the decline of orchids in Western Europe is the "closing" of meadows linked to the **abandonment of agro-pastoral practices** (Figure 3). The reduction of open areas has also led to a fragmentation of populations which, isolated from each other, can become, over time, so small as to risk local extinction.

In hilly areas the open habitats where orchids live

are all of secondary origin, i.e. **human-created** following wood cutting in more or less ancient times, and preserved through agricultural practices (grazing, mowing, etc.).

At first, the **abandonment of these lands** results in a **recolonization** from very competitive herbaceous species, like the bracken fern (*Pteridium aquilinum*) and the couch grass (*Agropyron repens*) that cause an **accumulation** of litter and inhibit the growth of orchids. Secondly, the **invasion** of woody species occurs, shrubby ones at first, like the blackthorn (*Prunus spinosa*) and the dog rose (*Rosa canina*), and then trees like silver birch (*Betula pendula*) and common aspen (*Populus tremula*), determining the **disappearance of grasslands** in favour of the woods.

In the last decades, in Italy and in general all over Europe, a **major decrease** in grasslands has been witnessed, both in terms of surface area and in terms of quality. Today the remaining patches of grassland are often either limited to very steep and rocky surfaces

Sub-mediterranean and hill orchids of open meso-xerophile environments			
Hemi-heliophilous species (shade-tolerant)		Heliophilous species (not shade-tolerant)	
Mesophilic species (not too dry habitats)		Mesophilic species (not too dry habitats)	
<i>Cephalanthera damasonium</i>	may-june	<i>Anacamptis coriophora</i>	apr-june
<i>Cephalanthera longifolia</i>	apr-june	<i>Anacamptis morio</i>	mar-june
<i>Cephalanthera rubra</i>	june-july	<i>Gymnadenia conopsea</i>	may-june
<i>Cypripedium calceolus</i>	may-july	<i>Neotinea tridentata</i>	apr-june
<i>Ophrys insectifera</i>	may-july	<i>Neotinea ustulata</i>	apr-june
<i>Orchis mascula</i>	apr-july	<i>Ophrys bertolonii</i>	apr-june
<i>Orchis pallens</i>	apr-june	<i>Orchis anthropophora</i>	may-june
<i>Orchis purpurea</i>	may-june	<i>Orchis militaris</i>	may-june
Xerophilic species (dry habitats)		Xerophilic species (dry habitats)	
<i>Epipactis muelleri</i>	june-aug	<i>Anacamptis papilionacea</i>	apr-may
<i>Epipactis placentina</i>	june-aug	<i>Anacamptis pyramidalis</i>	may-june
<i>Epipactis provincialis</i>	june-aug	<i>Epipactis distans</i>	june-aug
<i>Epipactis thesaurensis</i>	june-aug	<i>Epipactis tremolsii</i>	june-aug
<i>Himantoglossum robertianum</i>	feb-apr	<i>Himantoglossum adriaticum</i>	may-june
<i>Limodorum abortivum</i>	may-july	<i>Himantoglossum hircinum</i>	may-june
<i>Ophrys apifera</i>	may-june	<i>Neotinea lactea</i>	mar-apr
<i>Ophrys arachnitiformis</i>	mar-apr	<i>Neotinea maculata</i>	apr-may
<i>Ophrys araneola</i>	apr-may	<i>Ophrys atrata</i>	mar-may
<i>Ophrys botteronii</i>	june-july	<i>Ophrys aurelia</i>	mar-apr
<i>Ophrys drumana</i>	may-june	<i>Ophrys benacensis</i>	apr-may
<i>Ophrys sphegodes</i>	mar-may	<i>Ophrys fusca</i>	mar-apr
<i>Orchis olbiensis</i>	apr-may	<i>Ophrys holosericea/fuciflora</i>	may-june
<i>Orchis patens</i>	mar-june	<i>Ophrys lutea</i>	mar-may
<i>Orchis provincialis</i>	apr-may	<i>Ophrys massiliensis</i>	jan-mar
		<i>Ophrys passionis</i>	apr-may
		<i>Ophrys provincialis</i>	apr-june
		<i>Ophrys saratoi</i>	apr-june
		<i>Ophrys scolopax</i>	apr-june
		<i>Ophrys splendida</i>	apr-may
		<i>Ophrys sulcata</i>	apr-june
		<i>Ophrys tetraloniae</i>	june-sept
		<i>Orchis pauciflora</i>	apr-may
		<i>Orchis simia</i>	apr-may
		<i>Serapias cordigera</i>	apr-june
		<i>Serapias neglecta</i>	mar-apr

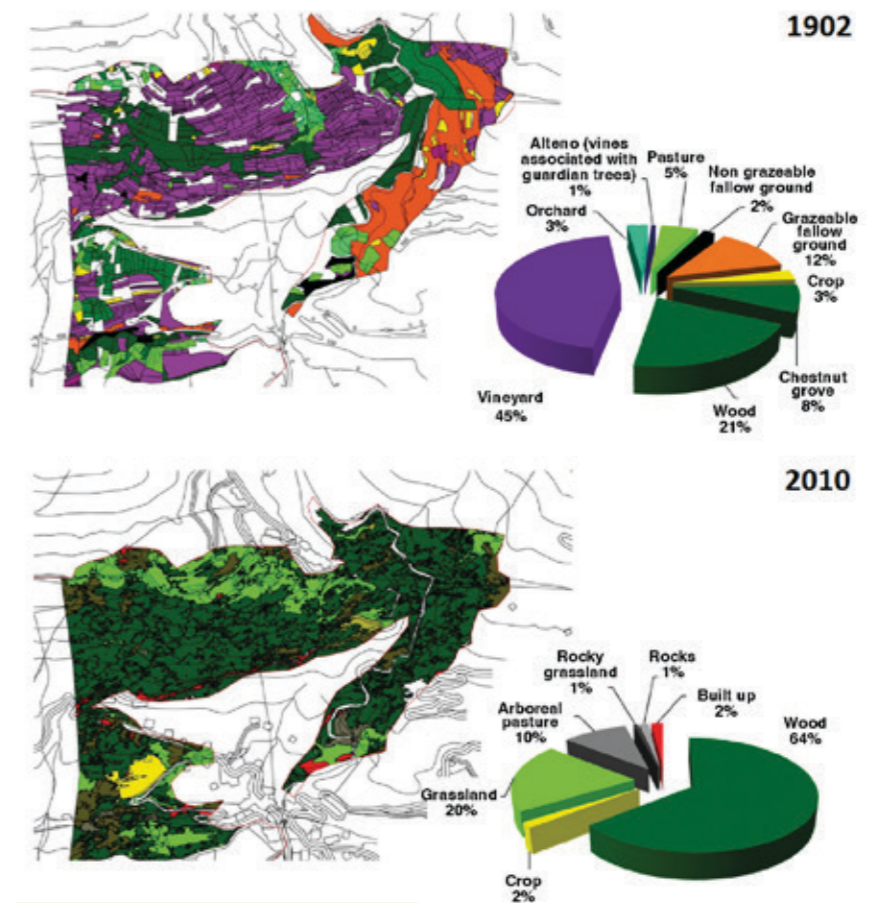
**Table 1.** List of orchids of the Alps (according to Landolt *et al.*, 2010) in the sub-mediterranean hilly areas, typical of dry and open habitats. Species of the montane, subalpine, and alpine belt and those typical of humid and wooded habitats are not included. For each species the flowering interval in months is indicated (data from Aeschmann *et al.*, 2004).

## FUN FACTS

The vast majority of species with showy flowers attract **pollinator insects** (butterflies, flies, bees, etc.) by offering them nectar with sweet sugars as a reward (upper picture). Some species of orchids, instead, like the *Ophrys* species, cheat insects through the so-called "**sexual deception**" (lower picture). Their **labellum** is deeply transformed, to the point of mimicking the female body of some insects, mostly bees and wasps. The deception is performed not only through visual and tactile signals but also through the production of **sex pheromones** by the flower (volatile substances imperceptible to the human nose, very similar to the ones produced by the females of the same insects to attract males). Males then try to mate with orchid flowers, carrying the pollen of the clever plant from flower to flower.

Orchids that don't produce nectar are surprisingly common and they account for a third of known species, yet not all of them

use sexual deception (known in Europe only for the *Ophrys* species). The majority of "deceptive" species attract pollinators simply by **imitating the flowers of other plants** (shape of the inflorescence, flower colour, scent, presence of fake pollen anthers, etc.), exploiting the instinctive behaviour of food search of pollinators (phenomenon called "**generalised food deception**") (Jersáková *et al.*, 2006). Quite often, these orchids bloom at the same time early in Spring, taking advantage of bees and bumblebees just awoken from hibernation. They benefit from the close presence of other nectariferous species since the latter increase the number of pollinators to deceive (phenomenon known as "**the magnet species effect**"). This is the reason why orchids have a greater chance of reproductive success in environments rich in biodiversity.



**Figure 3.** Change of land use in the area of Chianocco, Turin (LIFE Xero-Grazing, 2014).



Figure 4. Festuco-brometalia grasslands (habitat 6210\*) are dry grassland dominated by the presence of *Bromus erectus* (inflorescences in the foreground).

or, in the most accessible and mechanizable areas, they undergo an **intensification of agronomic practices** (irrational grazing and mowing or conversion to croplands).

This means that nowadays, grassland ecosystems are **less suitable for the growth of orchids** as compared to the past. But there are many other **reasons for this decline**, like the use of herbicides and insecticides, the intensification of olive and vine plantings and the unrestricted picking by collectors (Isaja *et al.*, 2017).

The majority of species belonging to the *Orchidaceae* family, due to their rarity and to the constant threats to their conservation, is included on all levels in the **red lists of protection**. At the global level, for example, in CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), in the Bern Convention and in the IUCN (International Union for Conservation of Nature). The red national list (Rossi *et al.*, 2013), listing the animal and vegetable species at risk of extinction in Italy, mentions **10 different species of orchids**.

At the European level, the measure of habitats and

species conservation is represented by Directive 92/43/EEC, the so-called "**Habitats Directive**" which not only **protects 5 species of orchids**, but deals also with the **conservation of habitats**, including dry grasslands (habitat 6210\*), semi-natural dry grasslands and scrubland facies on calcareous substrates of *Festuco-Brometalia*, which become a priority in preservation (gaining the asterisk associated with the habitat's code) in case they are "important orchid sites".

Most Italian regions have also contributed to the protection of orchids with conservation laws where many species are mentioned. In Piedmont, for example, under **Regional Law 32/1982** (and following integrations) all orchids of genera *Anacamptis*, *Cephalanthera*, *Cypripedium*, *Dactylorhiza*, *Epipactis*, *Gymnadenia*, *Himantoglossum*, *Nigritella*, *Ophrys*, *Orchis*, *Platanthera* and *Serapias* are protected.

## SOME NUMBERS

In Italy **areas covered by meadows and pastures** went from 18.6% of the national surface in 1960 to 10.1% in 1990 (Falcucci *et al.*, 2007), further falling to 6.1% in 2016 (Munafò & Marinosci, 2018), experiencing a **67% drop in 56 years**. In recent years, although, a gradual return to rural areas and the increase in organic agriculture are significant **signs of hope**. Indeed, until 2018, the percentage of organic farming, actual and in-conversion, involved 20.5% of olive groves, 15.2% of vineyards and 15.5% of hazel groves (SINAB, 2020; ISTAT, 2018).

## The abandonment of rural activities

We've understood that the major cause of decrease in the number of orchids is the abandonment of agro-pastoral activities. But what is the **reason for this abandonment?**

Grasslands suited to the majority of orchids are **dry and not very fertile**, hence not very productive. After World War II, with the **depopulation** of rural areas, a rapid abandonment of these surfaces took place, together with the invasion by trees and shrubs. The major causes of this abandonment are linked to **socioeconomic changes**, the depopulation of hilly and mountain areas in favour of big, industrialised cities, the introduction of productive models not suited to the marginal areas and the excessive land fragmentation.

To this day the issue of **property fragmentation** is still one of the major barriers to the resettlement of new farms in rural areas.

Due to the division of lands among heirs, nowadays the territory appears fragmented in **thousands of tiny plots belonging to different owners**.

As a result, a minimum farm area capable of ensuring a profitability sufficient to the preservation of agro-pastoral farms is not guaranteed (Probo *et al.*, 2016). Large-scale abandonment can **jeopardise the landscape and the usability of the territory**, exacerbate issues linked to the lack of maintenance (e.g. wildfires, landslides, etc.), negatively affecting the quality of life of residents, the recreational tourist value of the territory and its biodiversity, including orchids that in this context can become the **symbol of the quality of life** for the residents of a whole territory.

An interesting strategy to overcome limitations linked to land fragmentation and poor productivity consists in replacing individual land management with a collective one, with the aim of optimising the land yield. There are different methods to merge land areas, like purchase, exchange, lease or creation of farming co-operatives. However, these methods are usually unsuccessful in marginal areas due to the high cost of legal practices and the difficulty in finding the owners or heirs of parcels.

An interesting alternative, promoted in the last years by the Piedmont Region (which has been a forerunner for other Italian Regions) are **Land Associations**.



Figure 5. Dry pasture with *Neotinea tridentata* being invaded by blackthorn (*Prunus spinosa*), Bussoleno (TO). Note the large accumulation of unused herbaceous litter on the ground.

## LAND ASSOCIATIONS

In Italy Land associations, pursuant to Articles 14-42 of the Civil Code, are non-profit associations between owners of public or private lands allocated to agriculture, forestry or pasture in a certain territory. The aim of these associations is to **gather farmlands**, woods, abandoned or uncultivated areas and make them **usable from a productive and economically sustainable perspective**. In this way the maintenance or restoration of the productive function of lands is favoured and environmental and landscape characteristics are also enhanced through land improvements (viability maintenance, construction of water infrastructures, etc.). Land associations were born **in France**, where nowadays they are quite common, mainly for livestock rearing purposes (*Associations Foncières Pastorales*). **The first examples** of land associations in Italy date back to 2008 in Piedmont and their constitution is now regulated and financed by the Region through the Regional Law No. 21 of November 2, 2016, regarding all types of land (agricultural, forest or mixed ones).

**The management of lands** of a land association is entrusted to one or more farming businesses that commit to **enhancing and maintaining** lands and their productivity according to a management plan that needs to be written by a graduate agronomist or forestry expert and approved by the association members. Plots given to the land association cannot be acquired by usucaption and they remain a property of the owner and their heirs. Any **income** obtained must be **re-invested** into improvement interventions of land (viability, land and agricultural improvements, etc.).



## The importance of agricultural practices for biodiversity conservation

As mentioned above, the first cause of orchids' increasing scarcity in Italy results from the **abandonment of agro-pastoral practices**, with the following "closing" of grasslands or other similar agricultural environments like traditional vineyards or olive groves.

Therefore, these ecosystems **depend on management** to survive over time (Pierce & Bellotti, 2011; Adamowski, 2006). The management positively affects orchids through the "cleaning", i.e., the periodic removal of grass, whether it creates an income for the farm (hay production, direct feeding of grazing or stable animals, etc.) or whether it falls in the ordinary field cleaning operations.

Agricultural activities play a **double role** towards orchids and towards **biodiversity** in general. They indirectly enable the **maintenance** of open habitats favouring the presence of orchids in perimeter areas (ex. escarpments, roadsides, etc.), even where intensive agriculture is practised.

Farms play actually a **direct conservation role** if extensive farming is practised in ways that are suitable to the needs of the orchids also within cultivated areas. This kind of activity can be complex to implement in intensive conventional cultivations, but they often represent the ordinary management in less productive areas or in amateur and family-run cultivations.

In the following chapters, we will investigate which agricultural practices are more **favourable to the spread of orchids**.

## The role of Orchid Stewards

An "**Orchid Steward**" is a person who is sensitive to the issues regarding orchid conservation (and therefore to environment conservation) and can contribute to it directly or indirectly, consistently with the idea of "**widespread conservation**".

At the forefront among Stewards we find **farmers, owners or renters** managing the land who can make the environment more suited to orchids' life through their choice of cultivation practices, contributing to the **conservation of biodiversity** and the maintenance of ecosystem services.

Unfortunately, supporting orchids often means to produce less, or at a higher cost, thus these practices might be implemented only on some parts of the farm, or the productive activity must integrate with other, non strictly agricultural, activities (more on this in the chapter "Orchids and farm promotion").

**Private owners** of small non-productive plots like gardens and small orchards can also be successful Stewards. Anyone can contribute to the same goals pursued by owners and managers through the Land Stewardship by encouraging a **mindful and respectful presence on the land** or the consumption of products coming from virtuous businesses.



Figure 6. Picture of a Steward with her orchids

## WHAT ARE ECOSYSTEM SERVICES?

**Ecosystem services** or "**nature's contributions to people**" (according to the recent rewording of the *Intergovernmental science-policy Platform for Biodiversity and Ecosystem Services*; IPBES, 2019) are the **direct or indirect contributions** of an ecosystem (agro-ecosystems included) to human well-being and they **support** our **livelihood** and **quality of life**.

There are four main categories of ecosystem services:



PROVISIONING SERVICES



REGULATING SERVICES



LIFE-SUPPORTING SERVICES



CULTURAL SERVICES

**Provisioning services:** resource production (e.g. food, water, wood, fibre, medicines, etc.)

**Regulating services:** processes like climate regulation, carbon sequestration, pollination, air and water purification, control of natural hazards, parasites containment, etc.

**Life-supporting services:** provision of a habitat suited to the life of different species and their genetic diversity.

**Cultural services:** spiritual enrichment, intellectual development, recreation, aesthetic, and landscape values.

In general, grasslands rich in orchids can provide important **advantages for society** (production, employment), **the environment and biodiversity**, although they are not always recognized or well understood. Cultivated fields don't contribute to carbon sequestration, while a grassland can capture from 0.3 to 0.6 tons of carbon per hectare per year. In addition, grasslands rich in species (orchids, other flowering plants, insects, raptors, etc.) have a **high recreational value** as they attract tourists, passionate naturalists, photographers, etc. (Calaciura & Spinelli 2008).

# 7 Grazing and mowing for orchid conservation

As already mentioned, meadows and grazing areas have fallen significantly in the last decades. The **abandonment of traditional agro-pastoral activities** has resulted in an extensive recolonization of these surfaces by woody vegetation.

**Mowing** (to produce hay, silage or for direct use of green grass in the stable) and **grazing** (direct use of grass with grazing animals) are in fact **essential activities** for the maintenance of meadows and pastures.

These areas have not only a **productive value**, but they can also **provide** several **ecosystem services**. Among them land accessibility, landscape value, decreased risk of fires but most of all the function of **biodiversity conservation** (i.e., keeping many vegetal and animal species inside) deserve to be mentioned.

The importance from a biological point of view is highlighted by EU conservation policies that identify many types of grasslands as **habitat of conservation interest**, especially dry grasslands which are important orchid sites (habitat 6210\*).

In order to support orchids in this kind of environment it is necessary to keep the soil not too rich in nutrients, a **low-height plant layer** with discontinuous sward which allows the presence of parcels of bare ground (Slaviero *et al.*, 2016), reducing biomass on the ground. **Irrigation** and **heavy fertilisation** must be avoided, while grazing and mowing must follow a precise frequency and seasonality.

Although meadows and pastures may seem similar in appearance, as they are both dominated by herbaceous species, with a close observation to the structure of the sward some differences can be seen. **Pastures** have a more heterogeneous structure, as grazing animals remove the grass in a selective way and create a patchy structure with low and high grass, thus allowing the cohabitation of light-loving species (in low grass) and shade-tolerant ones (in high grass). In **meadows**, instead, mowing causes a single simultaneous removal of the grass, resulting in a more uniform structure on the whole surface.



Figure 7. Festuco-brometalia grasslands usually host a rich plant and animal biodiversity and create favourable environmental conditions for many species of orchids.



Figure 8. A grazing flock of sheep in a dry grassland with Bromus erectus.

# 8 Meadows

**Meadows** are surfaces managed through **mowing**, usually for hay production.

An optimal management useful to the maintenance of orchids must rely on a **careful planning**, focussing especially on the following components:

- **mowing season:** it is recommended to perform a **single late cut** after the dissemination of orchid seeds. In case of very productive meadows, it can be necessary to also perform an early cut before the tillering of floral stems. Early cuts can be useful to monitor very intrusive herbaceous species like tor-grass (*Brachypodium pinnatum*).
- **cutting frequency:** as mentioned above, one to two cuts are recommended in summer, for a maximum of 3 cuts a year in case an early cut is also necessary.
- **method:** it is better to avoid using too heavy mowing machines in order to not overly compact the soil; a **cutting height of 8-10 cm**, never less, must be kept, especially during early cuts.

To maintain meadow productivity, fertilisations are often carried out. As **fertilisations** increase soil fertility, they create an **adverse environment for rarer orchids**. In dry meadows, the element that mostly limits plant growth is water availability (Fuhlendorf *et al.*, 2001). This implies that an increase in soil nutrients usually doesn't match a rise in productivity, making the employment of fertilisers useless.

Instead, in **damp and more productive meadows** fertilisation can significantly increase grass production. In both cases it is recommended to opt for slow-release **organic fertilisers** without exceeding in their use as orchids are very sensitive to competition with other herbaceous species. Too dense and productive meadows aren't an ideal habitat for most orchids.

# Pastures

**Pastures** are grasslands managed through **direct grazing** of grass by livestock.

Grazing allows to use and **preserve over time** grasslands with steep slopes as it is not bound to the use of mowing machines. Unlike **mowing** that only **removes biomass**, **grazing** also affects the nutrient intake through **manure supply** and **trampling** that favour a heterogeneous distribution of vegetation.

**Grazing contributes positively** by removing grass biomass, preventing the accumulation of litter and improving soil lighting conditions, a very important element for **sun-loving and less competitive orchids** producing a rosette of leaves near the ground. At the same time, grazing and trampling must not damage rosettes and flower stems, threatening the persistence or reproduction of orchids.

To promote the presence of orchids in a pasture, **grazing management** must be carefully **planned**, by acting especially on the following elements:

- **Selection of animal species:** each species has different grazing characteristics and effects on meadows ("Different species graze in different ways" box). **Mixed grazing** (carried out by using different species of grazers) can sometimes be useful to maintain grasslands biodiversity through the exploitation of the complementarity of different animal characteristics.
- **Selection of grazing period:** grazing should take place before the appearance of buds or after the fruiting of orchids in order not to undermine their reproduction, through a plot rotation, for example using fences and excluding the presence of animals on surfaces rich in orchids in full bloom.

- **Selection of (animal) stocking rate:** the number of animals grazing on a given amount of land over a certain period of time, called “**animal stocking**”, must be proportionate to the available forage (Box “*Animal stocking, overgrazing and undergrazing*”).
- **Selection of the grazing technique:** the optimal distribution of livestock on the pasture is reached by an **extensive grazing**, with a **low stocking rate** and an **even distribution of animals** on the surface, in order to prevent the formation of under-grazed areas with other ones over-grazed or with excessive concentration of manure. To obtain an even and balanced grazing it is often worthwhile to use the technique of **rotational grazing** where the grazing area is divided with fences in sub-areas (technically referred to as paddocks) that are periodically rotated to keep a homogeneous consumption of grass. In addition, rotational grazing allows to leave areas rich in orchids

undisturbed during flowering, so plants are not damaged, and their reproduction is not affected.



Figure 9. Cattle are not very selective grazers and allow to preserve secondary low altitude meadows over time.

## ANIMAL STOCKING, OVERGRAZING AND UNDERGRAZING

One of the easiest ways to determine **animal stocking**, i.e., the number of animals grazing on a given amount of land over a unit of time, are “**grazing days**”. They are defined by a whole number that represents the mathematical product between the number of animals and the number of days in which these animals must stay in a fenced area (technically defined as “**paddock**”). For example, if there are 100 grazing days inside a fenced area, it means it can keep 5 animals for 20 days, 10 for 10 days, 20 for 5 days and so on.

Sustainable stocking is the one in **balance with the forage supply of a pasture**, that can be calculated by quantifying the “**pastoral value**” of the pasture, i.e., the agronomical value derived by the vegetation composition (Cavallero *et al.*, 2007).

If the actual load is greater than the optimal load, **overgrazing** occurs, resulting in possible **damage** of the sward (orchids included), due to excessive grass removal, trampling and nutrient build-up.

On the other hand, if the actual load is lower compared to the optimal load, **undergrazing** occurs, resulting in accumulation of litter and appearance of shrub. Also, in this situation there is a **decrease in orchids**, in addition to a decrease in the agronomic value of the pasture. Therefore, it is really important to choose the right stocking in balance with the amount of forage available and the agronomic features of the pasture.

## DIFFERENT SPECIES GRAZE IN DIFFERENT WAYS

**Grazing animals** feed on grass in significantly different ways (Hamadani & Khan, 2016; Su *et al.*, 2018; Calaciura & Spinelli, 2008):

- **Cattle:** these animals are not selective and prefer to graze on **medium-high height grass**. As they rip the grass with a bite, they create a spotted sward structure and keep **meadows diverse**. Except for some hardy breeds, they are more demanding than sheep and goats, suited to more productive meadows featuring a high quality of forage.
- **Sheep:** they are very selective in their choices and are capable of **selecting the more appreciated herbs** with the tendency of creating a dense sward. They are **hardy animals** with a strong adaptability to hostile, dry and rough environments, also thanks to their low water needs. They are therefore suitable for the maintenance of **rough and rocky pastures that are less accessible** to cattle.
- **Goats:** they are primarily **browsers of shrubs and bark**, but they can also graze the sward. They are suited to **steep and dry terrains** full of bushes and they can be implemented to control woody vegetation in abandoned pastures.
- **Equine:** they graze in a **selective way** creating a varied and uneven structure of the turf by tearing plants at the base. They can graze even **rougher forages**, usually avoided by cattle and sheep, helping to **reduce the accumulation of litter** on the ground. **Horses** are heavy and can cause **damage to the soil by trampling**, while donkeys are lighter, more suited to hot, dry, and steep environments and since they are less selective than horses, they allow a better control of weeds.
- **Rabbits:** they are **strongly selective** and create an irregular patchwork of grazed areas at different heights.
- **Birds:** geese, chickens and other poultry are **omnivores** and they feed both on **vegetation** and **insects and seeds**. With their manure they can produce an **increase of nutrients in the soil**, especially of nitrogen, with negative effects on orchids that prefer less fertile environments.

The most suited grazing species of any area should be **chosen according to the conservation needs** and farm features, but in general for dry pastures rich in orchids the use of sheep or equine is recommended. Instead, goats are to be preferred for restoring abandoned pastures invaded by woody vegetation.

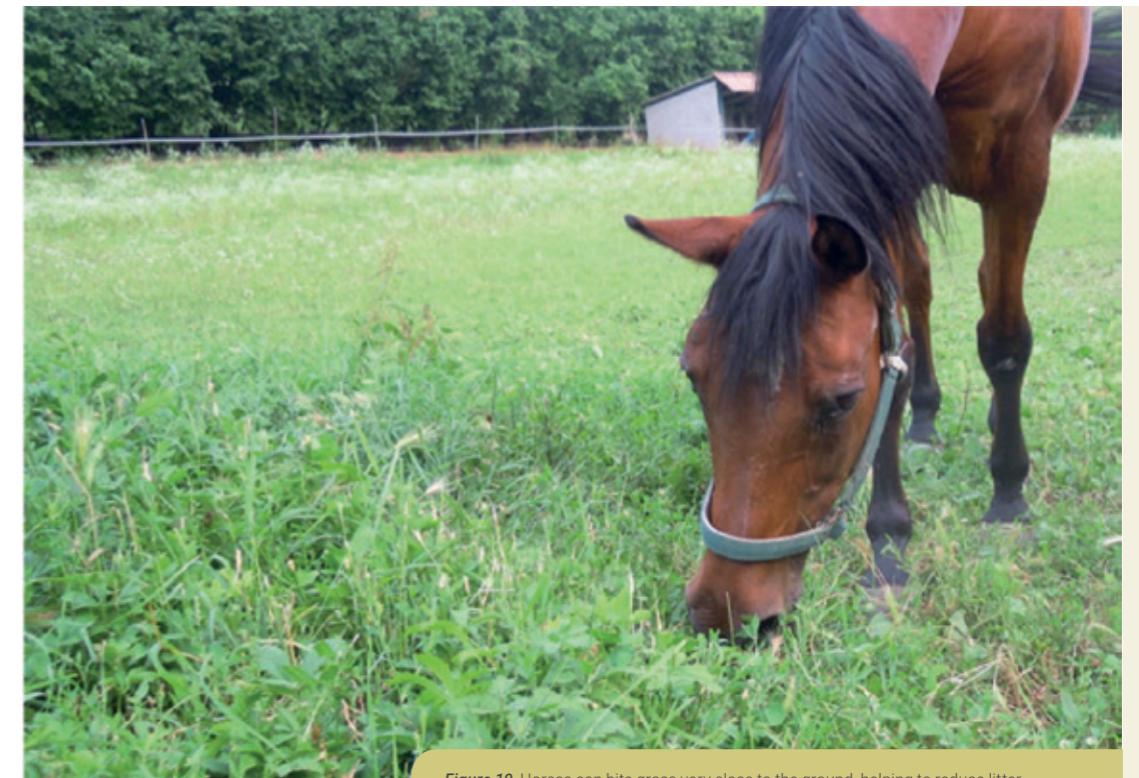


Figure 10. Horses can bite grass very close to the ground, helping to reduce litter.

# Croplands as a treasure chest of biodiversity

Orchid conservation doesn't stop at meadows and pastures. Many agricultural activities allowing an **undisturbed sward** (i.e., grassed over many years, without tillage) are compatible with the presence of orchids. For example, in traditional and very sunny vineyards and olive groves, a lot of orchid species typical of dry meadows can be found, like the species belonging to the genera *Orchis*, *Ophrys* and *Himantoglossum*. At the same time, hazel groves, which are usually more closed and shadowy, can host instead species typical of woodlands like the ones of the *Platanthera*, *Cephalanthera* and *Epipactis* genera.

Overall, even the **most intensive cultivations**, that usually don't host orchids within the cultivation surface, can help to maintain a varied landscape and can host **orchids in their perimeter**, mostly in ecotones between cultivated and uncultivated areas. We recall, for example, that in **hilly areas**, cultivated hillsides are often characterised by **terraces** and **embankments** to flatten cultivated surfaces.

Embankments, slopes between flat areas, are grassed plots that, if regularly mowed and cleaned, represent an excellent **shelter** for many species of orchids.

Nowadays, many farms keep orchids inside their crops and support the idea that a **balance between productive activity and the presence of orchids** (and the plant and animal biodiversity linked to it) is possible.

In Europe, the increase in the last decades of intensive cultivations with high planting density and weeding, along with the abandonment of cultivations of more marginal areas managed in a traditional way, has led to a **sharp reduction of farmlands potentially rich in plant species** (Allen *et al.*, 2006).

However, the **return to agriculture** in the last few years has encouraged farming towards a greater attention to environmental and naturalistic aspects (e.g., the use of organic plant protection products or **environmentally friendly products**). This social tendency, along with a greater awareness and attention towards environmental issues by consumers, has somehow balanced the negative trend.

A **sustainable agriculture** must include the planting of **species and cultivars suited to the local pedo-climatic context** to ensure healthier and more vigorous plants requiring **less phytosanitary treatments**. The rediscovery of ancient local cultivars, encouraged by many local farmers and municipalities, often supported by significant organoleptic qualities of products (at the cost of production volume), moves in this direction, and allows a certain optimism about the **role of agriculture in biodiversity protection**.

This handbook focuses especially on the **three most common cultivations of permanent crops** in north-western Italy (vineyards, olive groves and hazel groves), but potentially suitable conditions for the presence of orchids can also be found in other cultivations such as citrus, coconut, almond, apple, and other fruit tree orchards.

It is worth recalling that a **healthy agroecosystem** is not a monoculture (an area of farm land on which only one crop is grown) but rather a **patchwork of different environments and crops**.

To keep a **varied landscape** and allow colonisation by orchids, it could be important to diversify farm productions, leaving even just small plots of land to small woods or meadows.

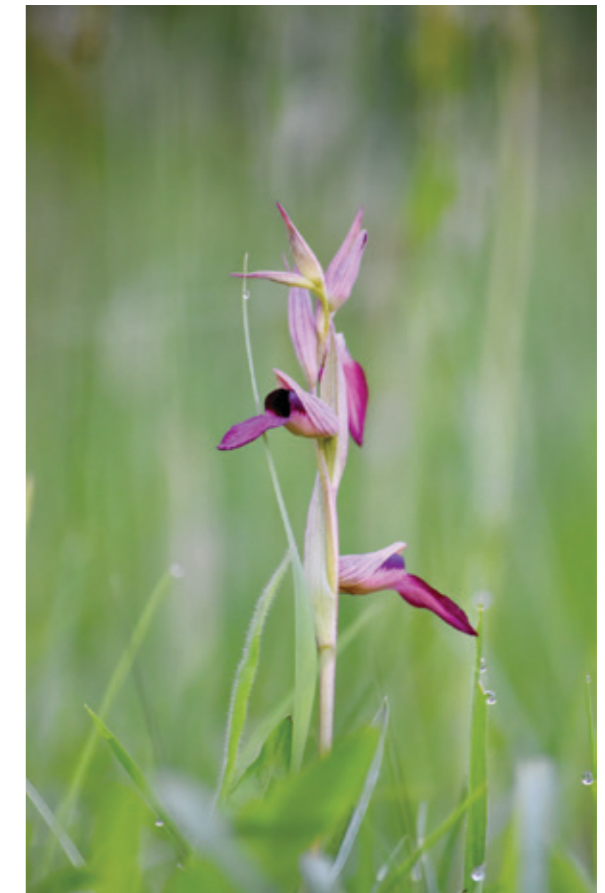


Figure 11. *Ophrys insectifera* (on the left) is a very shade-tolerant orchid, in this case the tree canopy (picture on the right) exceeds 85%.

## PEDOCLIMATIC NEEDS OF VINES, HAZEL AND OLIVE TREES

Listed below are the general needs of the different species; but it must be said that there are several different **cultivars with sometimes very distinct needs from each other**.

**Vine:** it prefers sunny and warm exposures and is sensitive to winter temperatures below -15°C and late frosts below -5°C. Since the vine is **highly adaptable** to both acid and basic soils and to different grain sizes and as there are rootstocks of all kinds on the market, the soil is not limiting. However, different soil characteristics greatly affect the organoleptic features of grapes.

**Olive tree:** it is sensitive to winter temperatures below 5°C, even if for a few hours it can withstand as low as -10°C. **It tolerates well high temperatures**, but it can be damaged by heat in case of water shortage or high relative humidity. **Relative air humidity must always be low, without fog.** It prefers loose, medium texture, draining soils with **low clay content** and southern exposure as it is heliophilous.

**Hazel tree:** it prefers **fertile, medium texture, fresh and permeable soils** with a neutral 5.5-8 pH, without excess lime and water stagnation. Minimum temperatures should not drop below -8°C during flowering and dry, rainless periods shouldn't be longer than a month. It needs about 1000 hours of cold weather.

# Vineyards

**Vineyards** are widespread throughout Italy and host a rich variety of flora and fauna that can be very similar to the ones of dry meadows (Nascimbene *et al.*, 2016). Orchids are important indicators of good management.

**Tillage** plays a key role in the presence or absence of orchids. Due to the complex interactions in the soil between orchid roots and the hyphae of mycorrhizal fungi, tillage should be **always avoided**.

**Ploughing or tilling**, in addition to destroying the root system of the species present, make the new tilled soil **hostile** for orchids by altering the fungal community, the nutrient cycle, and the microclimate (temperature, humidity, etc.) of the soil.

Under such conditions, it takes years, even decades for some species of orchids to re-colonize the area.

In addition, frequent tillage favours the presence of very competitive **herbaceous ruderal species** that slow down colonisation by orchids.

Therefore, tillage should be avoided both during the planting and the management of the vineyard. **Green manuring** (planting of leguminous and other herbs in the inter-row and their subsequent burial in the soil) determines the **disappearance of orchids** in the tilled inter-row. For this reason, if green manure is essential for the farm, it must be done on **alternate rows**, keeping tillage always on the same rows every year in order to leave non-tilled rows available for orchids.

The **main feature** that a vineyard must have is the **permanent grass of the inter-row**, that ensures a suitable habitat for many plant species, not only orchids but also species on which orchid pollinators feed on. These kinds of conditions occur in old, **not yet renewed**

**vineyards** (with distances of inter-rows of 1.0-1.2 metres) that often host rich orchid populations.

In recently planted vineyards (usually with wider inter-rows of 2.0-2.4 metres, to allow mechanisation), instead, ploughing has often caused the disappearance of previously present orchids.

Grass can be managed like a meadow or a pasture, preferring the approach which is most functional for the farm. **Grazing** must be carried out with cattle, equine and sheep livestock (with a preference for the latter since sheep are lighter and have less impact on the soil with their hooves), while **goats should be absolutely avoided** since they are primarily browsers and can severely damage grapes. Grazing should be avoided during the flowering and fruit development period as young fruits can be appealing for all livestock species.

**Grass removal through mowing** is easier for the farm to manage because it doesn't create side effects (stripping) to the main crop. In old vineyards rich in orchids, mechanised mowing with a tractor is almost impossible due to the limited space between the rows that doesn't allow the passage of a mechanical vehicle. Mowing is therefore carried out with a **shoulder mounted string trimmer** or with a small **self-propelled mulcher**. This operation is more expensive for the farm, but it has **two important advantages**: 1. the possibility to "dodge on sight" groups of orchids in bloom (avoiding the cut of flower stems) and 2. the reduction of soil compaction that could result from the passage of a wheeled or tracked farm vehicle (which is accentuated if the operation is done on moist soil).



Figure 12. Vineyards with a permanently greened inter-row can favour the presence of orchids.

Great attention must be paid to the time when the grass is mowed.

**Mowing** must take place before the growth of orchid stems (usually by March) and/or after fruit ripening (usually in late June/July, see Table 1 for flowering dates of different species). The latter option is normally preferred to reduce grass mowing to a **single annual intervention** and is extremely favourable for orchids. However, an **early cut** that doesn't damage rosettes increases their exposure to light and reduces grass competition during the growth of stems, favouring heliophilous and smaller orchids.



Figure 13. Vineyards with periodically tilled inter-row are not ideal habitats for orchids.

**Mowing during the flowering** of orchids must be **absolutely avoided**, even if it often goes against farm needs. For example, for spraying plant protection products (even if organic) it is necessary to remove flowers between rows in order to ward off pollinating insects that could be damaged by the treatment.

Grass mowing costs money to the farm since the grass is not reused in any way.

Grass is usually left on the ground where it degrades over time, providing organic matter to the soil. The most demanding orchids in terms of light can, however, take advantage if the **mowed grass is removed**, since this creates a **sunnier environment** on the soil surface. To support these species, the technique of **piling up mowed grass along the row** can be used. In this way, grass is used as mulching to contain the growth of grass along the row.

**Mulching of pruning residues** should be done in the same rows where green manure will be carried out and operations in rows dedicated to orchids should be reduced.

Even if this practice causes an increase in organic matter in the soil, it could result in a rise in fungal diseases of the vine. To support orchids, it would be better to **remove pruning residues from the ground**.

**Fertilisation** has a significant impact on orchids. An increase in soil fertility is harmful for most of them as they thrive in dry and nutrient-poor environments.

For the benefit of orchids, an optimal management would require the avoidance of inorganic fertilisers. Instead of using organic manure, an interesting solution could be using foliar fertilisation: the latter allows the distribution of fertiliser by sprinkling, reducing the nutrient supply in the soil. It is **recommended** to use **organic manure**, ideally along the rows or near the plant, better if buried (e.g., small holes made with a crowbar or a hoe filled with fertiliser). Irrigation should also be **minimised**, only in case of emergency irrigation.

Due to the complexity of the reproductive cycle of orchids and their close reliance on pollinating insects as well as mycorrhizal fungi, the **use of plant protection products, fungicides and insecticides** should be **minimised** (at least in some less productive portions), in line with farm needs.

The **replanting of an old vineyard** at the end of its crop cycle is a delicate moment. Usually, the old vineyard is fully replaced after tillage, with the aim of making it mechanizable (the new rows will be planted at a distance greater than two metres to allow the passage of tractors). However, the biological features of the soil and the vegetation of the rows (including orchids) will completely disappear and it's unlikely that a similar ecosystem in terms of biodiversity will recover in the short term. One of the available solutions could be to **keep the old planting pattern** by gradually replacing only dead or no longer productive vines with new grafted vines (it is estimated that **every year about 3% of plants** are replaced).

In the first years, **young vines**, which are in **competition with the old plants**, produce stalks that are smaller but that, thanks to the higher skin-to-pulp ratio of the grapes, can provide the wine with organoleptic features that are enjoyed by the most demanding consumers.



Figure 14. Green manuring implies tillage which does not favour the presence of orchids.

During the **plantation of new vines**, keeping the **grape fruiting cane higher than then average grass height** (e.g., 80-90 cm) could be a great way to reduce issues linked to the competition with grass.

The problem of the mechanisation of old vineyards can also be partly solved. As the planting pattern of rows cannot be expanded, a **network of access routes to the vineyard** can be planned and achieved by sacrificing a row every now and then (for example one for every nine rows). In this way, phytosanitary treatments can be carried out by treating 4 rows on one side and 4 rows on the other of the access network, adjusting it to the available machinery of the farm (for example the range distance of the machinery used to spray phytosanitary products).

**Orchids will be less numerous in the areas with access roads** (also due to soil trampling), but they will **thrive in the unworked inter-rows**. The issue regarding the grass mowing would remain and it should be solved either with a shoulder-mounted brushcutter or with small mowers, probably difficult to find in the national agricultural market.



**Figure 15.** The use of heavy tracked vehicles could result in excessive soil compaction and create unfavourable conditions for orchids.

## Olive groves

Olive groves are worthy of protection both as important elements of the historical and landscape heritage, and because they play a significant natural role, as they can host even very rare animal and plant species. Overall, olive groves are **very sunny**, since sunlight is a key factor to ensure a high lipid content in fruits. In **traditional olive groves**, the **planting density is low** (less than 200 plants per hectare against the 250-400 plants per hectare in intensive olive groves) and over 50% of the sunlight reaches the ground favouring the presence of herbaceous species similar to the ones that can be found in dry meadows. The abandonment of traditional olive groves or the intensification of agricultural practices results in a decrease of the most interesting herbaceous species, including orchids (Maccherini *et al.*, 2013).



**Figure 16.** Old traditional olive groves with grassed surfaces are very sunny so they represent an interesting habitat for heliophilous meadow orchids.

Changes in olive grove conditions in Italy differ from one region to another: in Liguria, for example, many traditional terraced olive groves have been abandoned in the last decades. Meanwhile, in Sardinia and Apulia olive cultivation has instead increased. However, many of these **new plantings are intensive**, featuring frequent irrigations and heavy mechanisation, and are thus not suitable for the establishment of populations of orchids (Pienkowski & Beaufoy, 2002).

**Soil tillage** must be absolutely **avoided**. In fact, as for vineyards, any type of soil tillage destroys the existing vegetation which is replaced by very competitive herbaceous ruderal species, making the ground inhospitable to orchids. Without tillage it is possible to keep a permanent herbaceous cover underneath the canopy throughout the year. The mowing of the herbaceous layer must be done in a period compatible with the life cycle of orchids, **avoiding** at all costs the **flowering period**. Fortunately, unlike in vineyards, in olive groves it is possible to **delay the mowing until July** in order to avoid damaging the orchids, since phytosanitary treatments are not carried out before July. However, if management needs require to anticipate the cut, it is recommended to do it with **portable machinery** (e.g.,

shoulder-mounted brushcutter) that allow to dodge orchids on sight, or else shred or mow **before the tillering of flower stems**, usually by March.

Olive groves have fewer shortcomings than vineyards for **grazing** with livestock. Therefore, grazing can be a **good** way to manage the grass layer (following the rules described for pastures) and simultaneously diversify farm activities. Finding livestock remains an issue, since livestock farms with the characteristics suitable for grazing in olive groves (animal species, number of animals, breeding system) are not always available nearby.

**Pruning residues** can be chipped, shredded, or burned. In the first two cases it is recommended to **reduce as much as possible the supply of chopped material to the soil** (e.g., leaving it near the trunks) to **avoid the negative mulching effect** for some orchids. In the last case, **burnings** should always take place **in the same locations**, as heat irreversibly damages the soil and the vegetation.

As for **fertilisers and soil conditioners**, they should be worked into the soil either **within 1.0-1.5 m from the trunk**, or, if possible, in well-defined spots with a hoe or a crowbar. The widespread distribution on the surface provides an even increase of fertility, favouring tall herbaceous species, which are more competitive than orchids in more fertile environments. Orchids are also limited by irrigations: most species thrive in dry environments where competition with other herbaceous species is limited.

**The use of plant protection products**, especially insecticides, fungicides and herbicides **must be minimised**. Unfortunately, in some areas the damages caused by the olive fruit fly are so serious as to require **specific treatments**. However, these treatments should be carried out after the end of the flowering period of orchids in order not to affect orchid pollinators. As for vineyards, **replanting** is a **very delicate phase**. A heavy tillage of the soil on the whole surface would completely remove the permanent grass layer and thus the associated orchids. **Soil tilling restricted to the planting point** is always recommended, with the timely removal only of dead or unproductive olive trees. Besides orchid preservation, this procedure also allows to avoid replacing the entire olive grove, while spreading plant costs over time.

# Hazel groves

Hazel groves differ from other cultivations because, when in full production, they feature a thick canopy that heavily reduces the **sunlight** reaching the **ground**. However, if properly managed, they can also become ideal habitats for many orchid species, in particular those typical of wooded areas since they tolerate partial shade (e.g., *Cephalanthera longifolia*, *Ophrys insectifera*, *Orchis purpurea*, etc.; Figure 17); while heliophilous species can thrive along the borders of the grove (Table 1).

As for vineyards and olive groves, **the surface** below hazel trees should be kept **grassed**, by avoiding tillage both at the time of planting and during cultivation. **Grass** should be **mulched after orchid dispersal**, which is luckily the normal case for hazel groves: grass removal is indeed essential only at the end of July, to ease the harvesting of fruits fallen to the ground, even if it is sometimes carried out in spring to limit herbaceous species.

It is also possible to graze grassed surfaces with **sheep**, which (unlike goats) are also very effective in limiting shoot development from stumps, without affecting the bark of hazel trees. It is clearly necessary to **move the livestock when grass begins to run low** because if food is scarce, also sheep can feed on the bark.

Hazel grove grazing is an uncommon practice and it strongly relies on the availability of animals in the farm or of nearby livestock farms with the right requirements (animal species, number of animals, breeding system, etc.). If grazing is undertaken, it will still be necessary to use a **mulcher before the fall of hazelnuts** in order to ease their harvest.

Partial shade orchids, as well as heliophilous ones, are

not favoured by excessive fertility of the soil. Therefore, a **localised organic manuring** rather than a widespread one should be preferred. Fertiliser should be added on the surface within one metre from the trunk, or even better through holes made with a hoe or a crowbar in order not to excessively increase the nutrients in the inter-row. The placement of the fertiliser into the soil allows better incorporation into the soil and reduces losses. Irrigations are not recommended unless they are necessary for the survival of the trees (emergency irrigations in case of drought).

In organic agriculture **green manuring** is often used to increase soil fertility. However, the unavoidable tillage implied by this practice results in the **destruction of the sward and of the orchids**. If necessary, as indicated for vineyards, it is recommended to **work on alternate rows**, keeping the same rows every year in order to always have a permanent grassed surface that can host orchids.

**Treatments with plant protection products**, as for vineyards and olive groves, must be **reduced to the absolute minimum**.

Adopting **preventive agronomic practices** that reduce the frequency of these treatments is preferable. For example, a good practice to reduce the number of stink bugs is to **leave pruning residues**, in late autumn, in piles throughout the hazel grove that will **attract stink bugs** searching for a shelter for wintering. These piles will be immediately burned by the end of winter, before the awakening of lethargic bugs. Pruning residues can also be shredded and spread to add organic matter to the soil, but this could be detrimental to some orchid species where the accumulation of residues is greater.

**New plantings** should be done **minimising tillage** in order to produce the least possible impact on the soil. Soil ploughing or trenching favour the mineralization processes of organic matter, altering the delicate balance of the soil fungal flora (on which orchids depend) and favouring the presence of very competitive annual herbaceous species. **Tillage** should be **limited to the planting points of cuttings, or to the length of the row (linear tillage)**.

The replacement of old plantings should be managed through **gradual replacements of the dead or decaying hazel trees**, with localised tillage and replacement with new cuttings to favour the maintenance of grassed areas in the plot surface.

During the **planning of a new planting**, it could be convenient to **delimit grassed hazel-free perimeter areas** a few metres wide. These grassed areas can be very useful if the hazel grove neighbours a wood, to break the continuity between the wood canopy and the hazel trees, thus limiting the access of dormice and other rodents that feed on hazelnuts.

These open areas also allow the **establishment of heliophilous orchids**, as long as the sward is grazed or mowed according to the procedures described above for meadows.



Figure 18. Tillage in the first years following the planting of a new hazel grove leads to unfavourable conditions for the development of orchids.



Figure 17. *Orchis purpurea* is a shade-tolerant orchid that can be easily found within hazel groves.

## GLOSSARY OF FARMING PRACTICES

Not all readers of this handbook are farmers, so we thought it would be helpful to add a short glossary of some agronomic terms:

**Grape fruiting cane:** long, one-year-old vine branch that will produce the current year's fruits.

**Shredding:** the act of **reducing wood and prunings** in shavings or splinters.

**Harrowing:** superficial tillage of the soil used to **break up big and compact clods of earth**, also useful for breaking the superficial soil crust or for the burial of seeds and fertilisers.

**Milling:** tillage made with rotary cutters that allows the **shredding and mixing** of the most superficial part of the soil.

**Plant protection products:** they are used to **protect crops or to affect their vital processes**. The protection is against all harmful organisms, insects (insecticides), mites (acaricides), fungi (fungicides) and other microorganisms. Herbicides also feature among plant protection products for the destruction of undesirable plants.

**Subsoiling:** tillage for compact soils made with **vertical cuts** that result in a reduced soil alteration, allowing to **break the tillage pan**.

**Trenching:** **deep tillage** (more than one metre in depth) of the soil, usually made before the planting of permanent crops.

**Mulching:** the process that involves a **mechanical shredding** of stubble, pruning residues, herbaceous vegetation, or other organic matter on the soil surface.

# Guidelines summary

Good cultivation practices that can favour the conservation or spread of orchids are summarised below:

- **Avoid ploughing, subsoiling, or milling.** If necessary, it would be better to restrict them to **point or linear interventions**, avoiding tillage on the whole surface (since tillage favours the spread of ruderal and invasive herbaceous species competing with orchids). For new plantings **avoid trenching** or **choose less invasive or localised tillage** (gradual replanting of single plants).
- Create the **favourable conditions for a permanent sward** resembling dry grasslands with low productivity. **Orchids suffer from competition** with tall herbaceous species and the accumulation of dry unused grass, therefore mowing, grazing, or mulching grass are essential. **Grass must be mowed/grazed before the development of the orchid flower stems** (usually February-March) **or after fruit ripening and seed dispersal** (usually June-July). If possible, consider the removal of mowed grass or its accumulation along the planted row. If mowing cannot be delayed, it is recommen-

ded to **use equipment that makes it possible to avoid the largest groups of blooming orchids** (Box "Flowering period of orchids").

- **Expand cleaning and grass removal operations** to include the non-productive surfaces of the farm (embankment slopes, abandoned marginal areas, ecotones, etc.), in order to contrast the negative effects of abandonment by limiting operations at the end of the vegetative cycle of orchids.
- **Use light machinery** (self-propelled rototiller, motorized wheelbarrow, shoulder-mounted string trimmer, self-propelled deflector machine). The use of heavy machinery leads to the compaction of soil, that should then be aerated through harrowing or subsoiling which are not compatible with the presence of orchids.
- **Minimise irrigations and inorganic fertilizations** to the bare necessity. Most orchids prefer dry and less fertile grassy habitats and inorganic fertilisers rapidly transfer a large amount of nutrients in the soil.

- Do not spread **organic manure** on the whole surface but rather apply it **at specific points**, if possible by inearthing it near the stem or in the row by making holes (with a hoe or a crowbar) in order not to overly increase the fertility of the inter-row.
- **Limit green manuring** (cultivation and burial of legumes and other plants) **to alternate rows** (as tillage is always harmful to orchids), repeating green manuring **every year** on the **same row** to allow the undisturbed presence of orchids in the unworked and permanently grassed rows.
- **Minimise the use of herbicides, insecticides, fungicides** and try to avoid their release during the flowering period.
- **Limit planting density**, allowing interrows to receive sufficient sunlight.
- **Keep roads grassed** to both avoid water runoff and to allow orchids to colonise edges.

- **Burn pruning residues always in the same places** in order to limit the impact of the heat released by the fire on herbaceous vegetation to selected areas.
- **Control alien and/or invasive plant species.**
- **Do not drain or reclaim humid areas** (if any), in order to keep a diverse environment.
- Where possible, **install fences to avoid damages** to crops and orchids by **wild boars**.
- **Favour intercropping**, planting of hedges or the maintenance of uncultivated or wooded areas alternated with grassed embankments and meadows, to support the colonisation by orchids and other plants, but also the presence of insects and other animals (orchids propagate best in species-rich environments and benefit from any operation that can positively affect the entire agroecosystem).
- **Install nest boxes** (so called "bug hotels") for pollinator insects.



Figure 19. *Himantoglossum robertianum* (on the left), *Cephalanthera rubra* (in the middle) and *Spiranthes spiralis* (on the right).

## FLOWERING PERIOD OF ORCHIDS

The **blooming date** of orchids **varies widely** depending on the species. Earliest species start to bloom even in **December/January** (e.g., *Himantoglossum robertianum*, *Ophrys massiliensis*), while later ones bloom **until August** (e.g. *Epipactis muelleri*, *Epipactis placentina*), with some exceptions such as *Spiranthes spiralis* that blooms between **late August and early October** (Figure 19). However, the vast majority of the species most common in the farm environment blooms **between April and June** (Table 1).



## Orchids and farm promotion

Agricultural productions should aim not only at **environmental** but also at **social and economic sustainability** (Vanclay, 2004). The adoption of environmental improvement practices must go hand in hand with an income that allows a decent life for farmers. Alongside great advantages for the environment, human health and the quality of products, practises that favour orchids may result in decreasing production volumes and increased costs for the farm that cannot always offset them with an increase in the sale price justified by a product quality improvement.

It is therefore necessary to **promote the recognition of the environmental value** not only of products but also of practices and land management and protection choices associated with them; hence the need to raise awareness among consumers who can then take an active role in orchid protection and in Land Stewardship even when they do not directly own cultivated crops.

In the last few years, there has been an **increasing interest towards more eco-friendly products** and towards tourism linked to the agricultural and natural environment. The preference for local agritourism and B&Bs offering genuine and high-quality products has greatly increased among Italian tourists, but especially among foreign tourists coming from central and northern Europe (Santeramo *et al.*, 2017).



The **wine sector** provides a perfect example of how Italian and foreign tourists are increasingly looking for quality and certified products, visiting wine cellars and vineyards, acknowledging the close relationship between the environment in which cultivation takes place and the resulting product (Castellini *et al.*, 2014).

The creation of **accommodation facilities** or joint initiatives with existing ones, by which agricultural products are supplied in exchange for **guided tours carried out on the farm**, can be a solution to reach a greater number of customers and in particular those who are more aware and therefore willing to spend more for the products offered. In this context, the organisation of **naturalistic** or **historical-cultural** events, bioblitz, guided visits for groups of nature or orchid enthusiasts, etc. can come together as opportunities to promote a **vital land**, comprising also farm visits offering the chance of buying products linked to the protected land itself.

Thus, through our informed choices, we can all support Orchid Stewardship.

## The importance of the community

As recalled above, social sustainability is important too. In the last decades, agriculture has gone from socio-cultural practice to a mere technical activity (Vanclay, 2004). The conservation of agriculture depends on the **survival of a rural community**, of **culture, ancient knowledge** and expertise that have integrated into the environment and the landscape over the centuries, guaranteeing **sustainable productions** in the long run. Agricultural and tourist activities, processing of raw products, livestock breeding, grocery stores and professionals can join at the local level in a single **collaborative productive community** that puts the value of the land first, sharing the idea that soil, woods, crops, pastures and flowers as a whole provide ecosystem services enjoyed by the whole community. An effective resilience of the agricultural and productive system of marginal rural areas relies on the collaboration of the local community.

Creating a network of contacts and partnerships is therefore essential to succeed in enhancing products

from sustainable agriculture, selling them at a price incorporating the added value of an eco-friendly management. The network allows to **create a productive and tourism chain** with different types of farms, but it also allows the **exchange of ideas and solutions among farmers** who could even cooperate in the form of **consortia** or other types of aggregations. Cooperation with other farms can also provide an opportunity to learn new ways to advertise products, improve marketing skills, and thus the ability to stand apart in the global market. Unity is strength, always, even more so in marginal and less productive areas.

One of the aims of the **LIFEorchids project** is to create a **network of Stewards** that can interact with each other and share experiences, by connecting people with the same interests and goals.



## AGRICULTURAL CERTIFICATION

A big step forward to **promote the agricultural production of healthier and eco-friendly products** came from the EC Regulation N. 2092/1991 on organic agriculture. But unfortunately, the certification involves a **cost** and represents a **bureaucratic burden** for the farm that is not always able to compensate it through a sufficient surcharge on the product, despite the significant **gap between the price of organic products and the price of products from conventional agriculture** observed in recent years.

An important development came from CE Regulation N. 848/2018 which introduced the possibility for farmers with business below 5 hectares in order to **reduce the cost** by obtaining a **group certification**. Note, however, that **an organic certification is not necessary** to produce in an eco-friendly way, even if it clearly helps in promoting a product to potential customers particularly sensitive to environmental issues.

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