ISSN 2280-1855

PLANT SOCIOLOGY

formerly FITOSOCIOLOGIA

Volume 49 (2) - December 2012

RIVISTA SEMESTRALE - POSTE ITALIANE S.P.A. - SPED. ABB. POST - D.L. 353/2003 - (CONV. IN L. 27/02/2004 N. 46) ART. 1, COMMA 2, DCB ANCONA | TASSA RISCOSSA - TAXE PERÇUE - CMPP AN
EDITO DALLA SOCIETÀ ITALIANA DI SCIENZA DELLA VETEGAZIONE ONLUS - PAVIA - DIRETTORE RESPONSABILE PROF. E. BIONDI - VOLUME 2 - II° SEMESTRE 2012

Journal of the Italian Society for Vegetation Science

Plant Sociology, Vol. 49, No. 2, December 2012, pp. 59-69
DOI 10.7338/pls2012492/04

PLANT SOCIOLOGY
©Italian Society for Vegetation Science

The phytosociological and syndynamical mapping for the identification of High Nature Value Farmland

D. Galdenzi, S. Pesaresi, S. Casavecchia, L. Zivkovic, E. Biondi
Department of Agricolture, Food and Environmental Sciences, Polytechnic University of Marche, Via Brecce Bianche, 60131, Ancona, Italy

Abstract
Rural activities have led to profound changes over the centuries of natural environment in Italy as in the rest of Europe by helping to define landscape mosaics in some cases very rich in biodiversity and habitats. In recent decades, however, the biodiversity of these ecosystems has been seriously compromise because of many variables, such as the intensification of agricultural production, land abandonment and the advancement of the urbanized areas. These changes have resulted in an uncontrollable loss of biodiversity and have been made evident also by an increase in hydro-geological instability, exacerbated by global climate changes in progress.
In order to reverse this process and restore the naturalness and heterogeneity of farmlands, European policies have implemented strategies for the conservation and sustainable use of biodiversity in agriculture. In this context, it has been suggested the need to counter the abandonment of land, mainly undertaken on the mountain and high-hilly areas, as a result of their economic marginalization, where the majority of Natura 2000 sites occurs. The E.U. introduced the concept of High Nature Value farmland (HNVf) to describe broad types of farming that, because of their characteristics, are inherently high in biodiversity. Typically, these are low-intensity farming systems harbouring high diversity of species and habitats, also of high conservation interest.
In general, HNV farmlands have been identified on the basis of the integration of land cover data (Corine Land Cover), agronomic and economic data relating to farm (FADN) and data regarding the distribution of flora and fauna species.
In this article, the criterion to identify and classify HNVf is based on the current and potential vegetation cover data obtainable from different integrated vegetation maps. For this purpose, in fact, the knowledge of the vegetation and the natural dynamics is proposed as an effective methodology for identifying and classifying high nature value farmlands since it is based on the documented ability of plant associations to act as bioindicators. We propose a cartographic-based methodological approach based on the use of vegetation data from which it is possible to synthesize and derive bioindicators able to quantify and qualify the levels of naturalness and landscape diversity of agroecosystems distributed on a territory and, therefore, to identify the HNV farmlands.
As a case study, we have considered the Marche Region located in Central Italy, on the Adriatic coast, for which we have very important vegetation data.

Key words: Biodiversity, Bioindicators, Extensive agriculture, Habitats Directive, HNV Farmland, Natura 2000 network, Phytosociology, Vegetation mapping.

Introduction

Over the centuries, the Italian and European natural environment has been profoundly modified by rural activities with a growing diversification of the landscape due to the introduction of new environmental scenarios. Environments so derived, if characterized by a heterogeneous landscape mosaic and low intensity production, are extremely rich in species and habitats (Tubbs 1977; Plachter 1996, 1998; Edwards *et al*., 1999).

In recent decades, the intensification of farming practices based on the use of high chemical inputs and machines associated with a high decline of typical elements of semi-natural landscapes, has strongly compromised this particular biodiversity and the presence of a large number of endemic and endangered species (Tucker & Heath, 1994; Lawton & May, 1995; Krebs *et al*., 1999; Robinson & Sutherland, 2002; Kristensen, 2003; Stoate *et al*., 2009; Lancioni & Taffetani, 2012).

The situation was further compounded by the abandonment of farmlands in the mountainous and high-hilly areas due to the economic marginalization (Baldock *et al*., 1996; Biondi *et al*., 2000; MacDonald *et al*., 2000) that triggered very serious erosion processes that may presage desertification in many areas of the Mediterranean basin (Ksomas *et al*., 2008). The expansion of towns and human infrastructures has also led to a strong reduction of agricultural land in the face of growing demand for food. To get an idea of the seriousness of the phenomenon in Italy from the 50s to date, an area of 1.5 million hectares have been cemented (ISPRA, 2010). These changes in land use have aggravated the economic condition of agriculture, which has been forced to increase production even in small areas in order to obtain an adequate economic profit.

In this context, the conservation of high nature value farmlands, subjected to extensive and traditional practices, proves to be a valuable tool for biodiversi-

Corresponding author: Simone Pesaresi. *Department of Agricolture, Food and Environmental Sciences, Polytechnic University of Marche, Via Brecce Bianche, I-60131, Ancona; e-mail: s.pesaresi@univpm.it*.

ty conservation of which these areas can be considered as "hot spot "of rural areas (EEA, 2004; Biondi, 2012; Biondi *et al.*, 2012). Their value for biodiversity conservation has been recognized in a number of policy documents from the EU Council Regulation on support for rural development (EC 1257/1999). Their conservation is considered an explicit objective in the context of rural development policy in the EU despite the lack of a clear and globally recognized definition of high nature value farmland has so far been an obstacle to the application of this concept. The kind of farm having the typical characteristics of the HNV farmland is the mixed, small size and "no-professional" one, with few sheep. These farms have a high proportion of permanent grasslands and average density of livestock of only 0.7 LU / ha (Beaufoy & Marsden, 2010). The lack of data on their distribution and their conservation status, that only a continuous monitoring can give, also prevented the application of effective policy measures (EEA, 2004).

The "Pan-European Conference on Agriculture and Biodiversity: towards integrating biological and landscape diversity for sustainable agriculture in Europe" (Paris, June 2002) apart from underlining the importance of the conservation of biodiversity both for the sustainable agriculture and rural development, was also an opportunity to encourage the Member States to identify high nature value areas among agro-ecosystems in order to implement the intervention tools in the management of the landscape and biodiversity provided by the Second Pillar of the CAP.

The same need has emerged in the Fifth Ministerial Conference "Environment for Europe" held in Kyiv in May 2003 (UN / ECE, 2003), during which the European Environment Ministers agreed to complete the identification of all high nature value areas in agricultural ecosystems in the pan European region areas, applying common criteria previously agreed upon in order to pay out the financial subsidies and incentive for the conservation and sustainable use of biodiversity in agriculture. This has been acknowledged even by the Italian government which in the National Strategic Plan for Rural Development 2007-2013, approved by the European Union, and specifically in the Axis II entitled "Improving the environment and the countryside" shows, with particular emphasis, issues related to biodiversity conservation and the protection of the agricultural systems of high nature value areas (Forconi, 2007). By 2008 (Art.22 of EU Regulation 1257/99) all HNVf to be subject to management procedures aimed at maintaining of biodiversity should have been identified at European level, using appropriate mechanisms, such as those provided by the Rural Development Plan, the programs for agri-environment schemes and those related to biological agriculture.

The identification and approximate distribution of HNV areas was carried out in the European context through the use of land cover data (CORINE, 2000), with a resolution of 1 km^2, integrated with biodiversity datasets referred to the period 2000-2006 (http://www.eea.europa.eu/data-and-maps/figures/approximate-distribution-of-hnv-farmland).

Unfortunately, at the national level, we are still lagging in the identification of HNVf, even at the regional level, and it is urgent that we arrive in a short time, through the activation of specific research projects, to the definition of an operative methodology applicable to different territorial contexts (ISPRA, 2010).

High nature value farmland describes those types of farming activity and farmlands that, because of their characteristics, can be expected to support high levels of biodiversity or species and habitats of conservation importance (Baldock *et al.*, 1993; Beaufoy *et al.*, 1994; Bignal & McCracken, 2000; Andersen *et al.*, 2003). This kind of farmland can be defined as low-yielding, low-input dryland systems retaining a sizeable proportion of semi-natural vegetation, including elements such as permanent pastures and features such as field hedges, headlands, patches of scrub and /or woodland (Baldock, 1999; Kabourakis, 1999; Andersen *et al.*, 2003).

In general, these areas are identified according to the integration of data of land cover (Corine Land Cover), agronomic and economic data relating to farms (FADN) and data regarding the distribution of flora and fauna species. Each of these approaches naturally shows its strengths and weaknesses as a result of insufficient reliability and availability of data and emphasizes the urgent need to enable accurate monitoring and use indicators that can perform this task (EEA, 2004).

For this purpose, the study of vegetation and natural dynamics inherent in it is proposed as a viable methodology for identifying and classifying high nature value farmlands since it is based on the documented abilities (Biondi *et al.*, 2004) of the plant associations to assume the role of bioindicators (Taffetani & Rismondo, 2009; Biondi *et al.*, 2011; Galdenzi *et al.*, 2011). The phytosociological method (Tüxen, 1978; Géhu & Rivas-Martinez, 1981; Géhu, 1986, 1988; Theurillat, 1992; Biondi, 1994, 2011), which investigates the plant landscape at different levels of detail, allows us to interpret the environmental aspects related to anthropogenic pressures and to define the quality of the ecosystem through the synthesis of macro-indicators integrable to each other (Biondi, 1996). These macro-indicators are a good starting point for a correct evaluation of the environmental quality (Biondi & Colosi, 2005) and then to identify the farmlands that may be considered as high nature value farmland.

A cartographic-based methodological approach able to identify and classify HNV farmlands is here proposed. It is based on the use of vegetation data, both

of phytosogiological and synphytosociological type, from which bioindicators suitable to quantify and qualify the naturalness and landscape diversity levels of agroecosystems and, therefore, to identify the HNV farmlands of a territory, were synthesized.

Materials and Methods

Land characteristics

The Marche Region is the case study proposed for the application of this methodology (fig. 1a). It is located in the Adriatic Central part of the Italian peninsula and covers about 9,365.86 km^2.

The Region is one of the most hilly of Italy: hills occupy 60% of the territory (5,583.70 km^2), while mountains represent 31% (2,902.96 km^2). The lowlands, occupying only 9% of the territory (879.20 km^2), are located in the alluvial areas along the rivers and pressed to the coastline.

The regional system of parks and nature reserves cover a total area of 89,557.32 ha, representing 9.56% of the whole territory. The sites that constitute the Natura 2000 network has a total area of 136,921 ha and represent 14.62% of the region, largely overlapping the national protected areas network.

Half of the region (50.38%) consists of Utilised Agricultural Area (UAA) that, based on the 6th ISTAT Census of Agriculture carried out in 2010, corresponds to 471,827.67 ha. This portion, compared to the previous census, has decreased by 4.2% and also the Total Agricultural Area (TAA) is decreased by 8.8%. The number of farms, 44,866, showed a decrease too (26.1%) if compared to the previous census. On the other hand the average UAA of farms has increased from 2.4 to 10.5 ha. Mainly, farms use their land for arable crops (87.5%).

In conjunction with the reduction of the UAA, in the last fifty years a significant increase in the urban areas has occurred which has contributed to an alarming consumption of soils not legitimized by the growth of population. According to the estimates documented by the Marche Region (Assessorato alla Tutela e Risanamento Ambientale, 2009) in the period from 1954 to 2007, the population has increased by 37% while the urban areas by 320%.

Methodology

The methodology followed in this paper evaluates and discriminates the presence of HNV farmlands according to a criterion of identification used by the European Community and based on land cover.

We used the vegetation map of the Marche Region on a scale of 1:50,000 (Catorci *et al*., 2007) to identify HNV farmlands.

This map was derived from the Marche vegetation information system (Pesaresi *et al*., 2007) which was implemented within the Marche Ecological Network project (REM) (Biondi *et al*., 2007) that contains phytosociological, synphytosociological and geosynphytosociological data which describe plant communities, vegetation series and plant landscape units according to Rivas-Martinez (2005), Géhu (2006), Biondi (2011), Blasi *et al*. (2011), Blasi & Frondoni (2011) and Pott (2011).

We derived the naturalness and landscape diversity maps from the phytosociological map.

A 1-km-squared grid was overlaid on the phytosociological map, in order to divide the area into cells with an identical surface and so comparable with each other.

According to the index described by Biondi & Colosi (2005), revised by Zivkovic (2009), and Galdenzi *et al*. (2011) we attributed the naturalness value (a value of 1 is attributed to areas having a very low naturalness value, such as urban or generally cemented areas and a value of 32 to areas having highest level of naturalness, such as forest types) to each land cover unit in the phytosociological map on the basis of the floristic-vegetation knowledge of the *syntaxa* and of the dynamic stages for each vegetation type within every vegetation series (*sigmetum*) and then we computed the naturalness in each cell using a weighted average. In this way we obtained the Naturalness Map (fig. 1b).

In order to obtain the landscape diversity map (fig. 1c) we applied the Simpson's Diversity Index (1949) for each grid cell starting from the phytosociological map. This index evaluates the landscape diversity in terms of richness in vegetation elements and the degree of equipartition of these elements. The values of the index range from 0 (maximum degree of environmental homogeneity) to 1 (high diversity and heterogeneity of the landscape).

We calculated the product of the two previously grid maps (Naturalness and Diversity map) to obtain a landscape representation which takes into account both the different levels of naturalness and landscape diversity of the Region. This resulting map (fig. 1d) allows to classify and map the HNV farmlands in the Marche Region by using the following criteria: a class that defines the best HNV farmlands of the region (AGRO1), where the farmland portion is less than 40% and the natural and semi-natural component for the remainder part; a second class (AGRO 2) in which the arable lands in each cell is greater than 40% and the values of naturalness and diversity index are relatively high (greater than or equal to 2); and a third class (AGRO3) wherein the arable portion is greater than 40% but naturalness and diversity levels are low but even acceptable (less than 2 and greater or equal to 1). The areas where the arable land greater than 40% and the naturalness and diversity index is less than 1 cannot be considered as HNV farmland and so were classified as

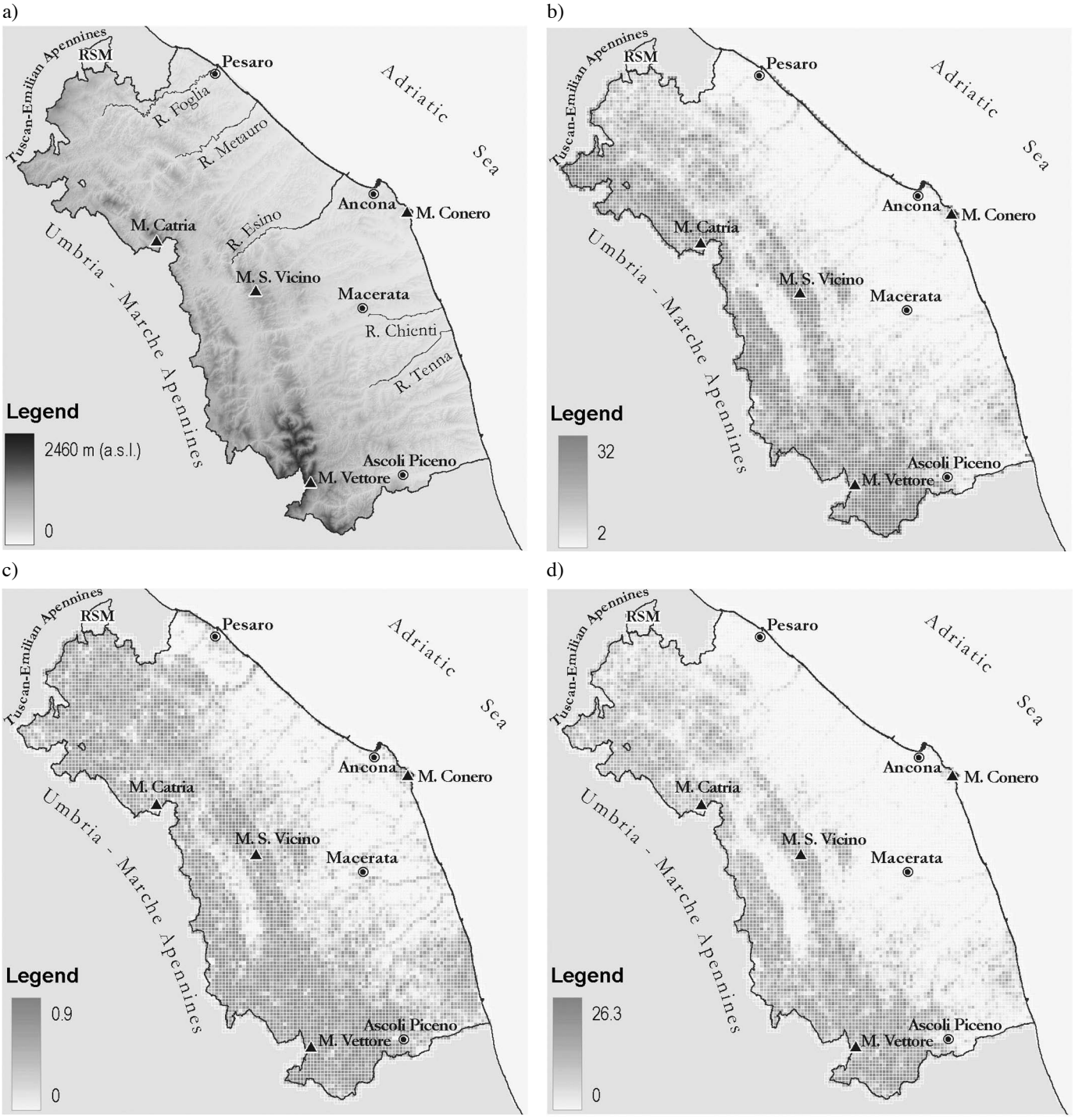

Fig. 1: a) The Marche territory; b) The Naturalness map (1 km cell size); c) The Landscape Diversity map (1 km cell size); d) Naturalness and Diversity map (1 km cell size).

"no HNV".

Moreover, we selected and classified all the cells characterized by the presence of grasslands and/or meadows as HNV areas of excellence (fig. 2).

Finally, we merged HNV farmlands and HNV areas of excellence and so we realized the HNV map of the Marche Region (fig. 3).

Results

The Naturalness map (Fig. 1b) shows higher values of naturalness on the Apennine chains and on Mount Conero. Intermediate values are distributed on high hilly areas (pre- and intra-Apennine sinclinorium) such as the surrounding hills of Mount Conero and the

southern coastal area because of the geomorphological characteristics preventing the development of intensive farming practices.

The other areas (coastal plains and low hilly areas) are instead characterized by low values of naturalness because of the strong anthropogenic pressures and an intensive agricultural management.

The Simpson's Diversity map (fig. 1c) shows a similar pattern: the agricultural component dominating plains and low hilly areas form landscape mosaics having low values. Even in this case the sectors that have high values of this index appear to be more focused on the Apennine chain and in some areas of the coasts, as well as along rivers and in particular hilly areas characterized by environmental mosaics richer in vegetation components.

The product of those two maps allows to amplify the qualitative and quantitative differences between areas with naturalness and landscape diversity characterized by different values of the considered index. Therefore, the rural areas in the Marche Region characterized by high values of naturalness and diversity index show a yet discreet or easily recoverable qualitative state of the agro-ecosystem, which allows us to identify them as HNV areas as specified in "materials and methods" paragraph.

Grasslands and meadows, selected by overlapping the phytosociological map with the 1-km-squared grid, occupy the 33% of the Marche Region. In Table 1, grassland communities that represent the HNV areas of excellence in the Marche Region are listed. Most of them (88%) are habitats listed in Annex I of the Habitats Directive 92/43/EEC and for this reason their meaning and value in conservation terms is even stronger as they host very high levels of biodiversity.

Among other types that are not included in Annex I of Habitats Directive, it is possible to recognize early aspects of the natural processes of vegetation recovery, such as post-cultivation plant communities (e.g. *Senecio erucifolii-Inuletum viscosae*, *Agropyro repentis-Dactyletum glomeratae*), characterized by lower levels of biodiversity but able to prevent soil loss thanks to the rapidity with which these types of vegetation colonize the abandoned land and, at the same time, enrich the floristic composition (Biondi *et al*., 2006).

Other mesophilous and xerophilous phytocoenoses taken into account, having a secondary origin, are characterized by a high number of species, including many rare and endemic species, whose role in the conservation of biodiversity is well defined in European policies. Moreover, we have included those herbaceous communities that can be defined "sub-primaries" (Biondi *et al*., 1988) because of the lithologic and ecological conditions where the evolution of the soils and consequently the establishment of a more complex vegetation is strongly compromised (stopped serial

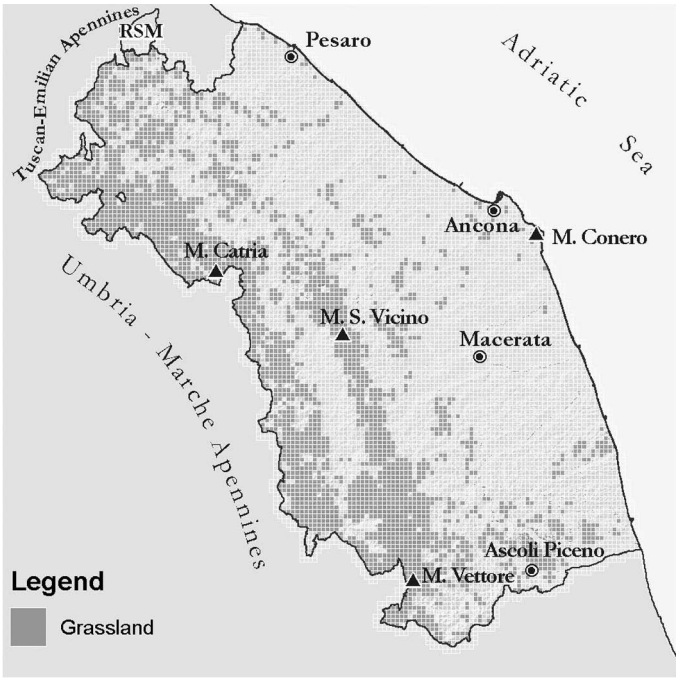

Fig. 2 - Distribution of grasslands with a 1 km2 resolution in the Marche Region

stages). These are very peculiar Apennine communities characterized by a large number of endemic and sub-endemic species.

As far as areas affected by the regional farming activities are concerned, the identification of HNV farmlands took into account not only land use but also the value of the naturalness and diversity index assigned to each investigated cell.

The identified HNV farmlands, occupying 32% of the regional territory, were classified into three classes. The 4% of them occurs in AGRO1 class, mainly distributed in the high hilly areas, in the inner part of the Region. The AGRO2 class represents the 20% and the AGRO3 the 8%.

Finally, the remaining areas classified as "no HNV" (35%) are those that, for the considered criteria, can not be defined as high natural value farmland due to several factors such as the type of implemented management but also the presence of urban areas and infrastructures.

Conclusions

The elaborations allowed us to identify and classify HNV farmlands in the Marche Region according to the adopted scale. This classification, indeed, becomes a valuable tool able to calibrate management actions and strategic solutions in order to convert those sectors characterized by a lower value in more sustainable terms and, at the same time, to preserve those features that confer high values of naturalness to other areas.

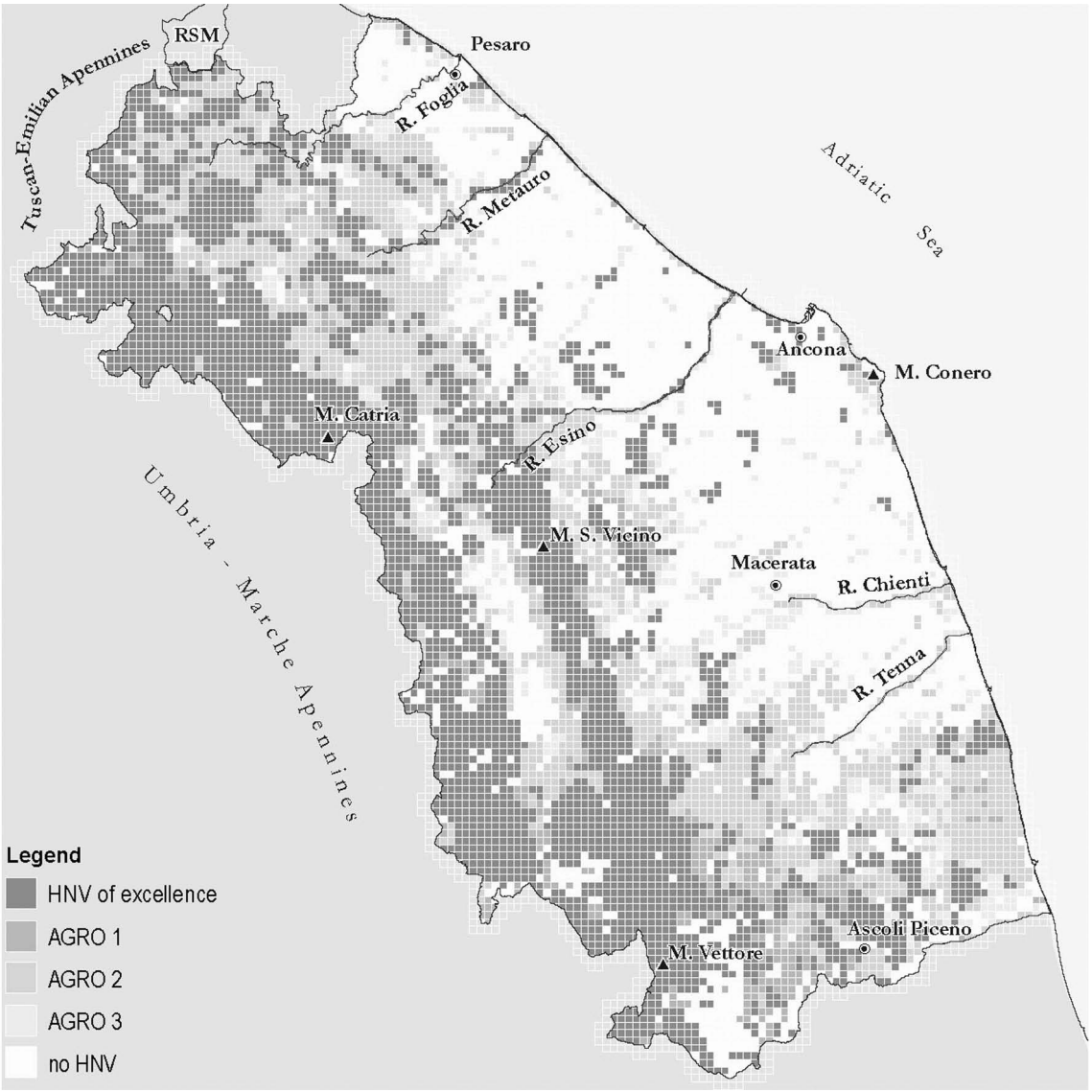

Fig. 3 - HNV farmland distribution map of the Marche Region.

A higher level of biodiversity is usually found in those areas where agricultural production systems make a lower use of fertilizers, pesticides, machinery. High levels of biodiversity can be even found in semi-natural areas with extensive agriculture or in rural areas where special structural elements such as hedges, grassy strips, rows of trees or patches of natural vegetation are preserved. However, it is possible that even in areas designated for more intensive agriculture, a high level of biodiversity can be found. By far, the greatest biodiversity is found in meadows and mountain grasslands; these environments in the Marche Region are attributable to a several habitats (Directive 92/43/EEC) as shown in Table 2. In general, in agro-ecosystems there are many types of habitat that can be attributed to plant communities having high naturalness, and these are also characterized by many different *syntaxa* (Biondi *et al*., 2012). Finally, agro-ecosystems with high naturalness participate in defining different landscapes throughout Italy (Blasi, 2010).

The agro-ecosystems with higher levels of biodiversity are commonly found where agricultural landscape is enriched by a complex mosaic of different habitats (Angelstamm, 1992). This heterogeneous mosaic makes the ecosystem able to regulate itself through the expression of its ecological functions, necessary for its survival and existence, and allows it to host a greater number of species of flora and fauna. In the Marche Region, these conditions can be found mainly in the higher hilly areas or where the hills have strong steepness. In these areas, in fact, agriculture still meets a rational land use, maintaining the common elements of diversification of the agricultural landscape: this allows to maintain the stability of slopes and limits the loss of soil to surface runoff (Galdenzi *et al*., 2011). The assignment of a quantitative value to this hete-

PHYTOSOCIOLOGICAL TYPE (AT ASSOCIATION LEVEL)	AREA (HA)
Achilleo collinae-Cynosuretum cristati Biondi *et al*. 1987	129,20
Achilleo tomentosae-Brometum erecti Catorci *et al*. 2006	575,83
Agropyro repentis-Dactyletum glomeratae (Ubaldi 1976) em. Ubaldi, Puppi & Speranza 1983	361,37
Agropyro-Asteretum linosyris Ferrari 1971	51,45
Asperulo aristatae-Fumanetum thymifoliae Allegrezza *et al*. 1997	62,76
Asperulo purpureae-Brometum erecti Biondi & Ballelli ex Di Pietro 2011	4828,45
Astragalo sempervirentis-Seslerietum nitidae Biondi & Ballelli 1995	2162,88
Brachypodio distachyae-Parapholidetum incurvae Taffetani 2000	342,35
Brizo mediae-Brometum erecti Bruno in Bruno & Covarelli corr. Biondi & Ballelli 1982	11064,69
Campanulo glomeratae-Cynosuretum cristati Ubaldi 1978	289,00
Caricetum kitaibelianae-rupestris Biondi *et al*. 2000	68,96
Carici humilis-Seslerietum apenninae Biondi *et al*. 1988	2920,38
Centaureo bracteatae-Brometum erecti Biondi *et al*. 1986	11207,07
Cephalario leucanthae-Saturejetum montanae Allegrezza *et al*. 1997	24,21
Colchico lusitani-Cynosuretum cristati Biondi & Ballelli 1995	1084,00
Convolvulo elegantissimi-Brometum erecti Biondi 1986	21,67
*Coronillo minimae-Astragaletum monspessulan*i Biondi & Ballelli in Biondi *et al*. 1985	647,18
Dauco carotae-Tussilaginetum farfarae Biondi *et al*.1992	32,52
Deschampsio-Caricetum distantis Pedrotti 1976	122,96
Festuco circummediterraneae-Arrhenatheretum elatioris Allegrezza 2003	182,03
Filipendulo vulgaris-Trifolietum montani Hruska *et al*. in Francalancia *et al*. 1981	330,00
Gnaphalio-Plantaginetum atratae Feoli-Chiapella & Feoli 1977	810,92
Helianthemo apenninae-Festucetum circummediterraneae Biondi *et al*. ass. nova	163,62
Loto tenuis-Agropyretum repentis Biondi *et al*. 1997	3,22
Luzulo italicae-Nardetum strictae Biondi *et al*. 1992	27,81
Ononido masquillierii-Brometum erecti Biondi *et al*. 1988	607,11
Polygalo majoris-Seslerietum nitidae Biondi *et al*. 1995	4779,16
Polygono-Xanthietum italici; *Polygono lapathifoli-Bidendetum* Pirola & Rossetti 1974	737,07
Poo violaceae-Nardetum strictae Pedrotti 1981	969,31
Potentillo cinereae-Brometum erecti Biondi *et al*. 2004	4010,29
Salvio pratensis-Dactyletum glomeratae Ubaldi *et al*. 1990	194,23
Scabioso maritimae-Cymbopogonetum hirti Allegrezza *et al*. 2006	3,46
Senecio erucifolii-Inuletum viscosae Biondi & Allegrezza 1996	2428,24
Senecio scopoli-Ranunculetum pollinensis Biondi & Ballelli 1995	4466,67
Seslerietum apenninae Migliaccio 1970 em. Bonin 1978	902,39
Seslerio apenninae-Dryadetum octopetalae Biondi *et al*. 1999	89,56
Seslerio nitidae-Brometum erecti Bruno in Bruno & Covarelli 1968	205,31
Other plant communities that are not defined in syntaxonomical terms	207,29
TOTAL	**57114,64**

Table 1 - The different plant communities making up HNV of excellence (HNV grasslands) in the Marche Region[1]

rogeneity is so extremely important when we have to evaluate the quality of an ecosystem and proceed to the identification of HNV areas.

Another essential parameter is the assessment of naturalness that defines the state of the HNV farmlands (IEEP, 2007a): the presence of portions of semi-natural vegetation surrounding the agro-ecosystem (such as forests, patches of shrublands, grasslands), gives the agricultural landscape a greater level of naturalness that can be so considered HNV farmland.

In the light of these considerations, the application of this methodology which takes into account the vegetation cover and the evaluation of naturalness and heterogeneity, can be considered a useful tool for identifying HNV farmlands according to the criteria defined by European reports (EEA, 2004; Paracchini *et al*.,

[1] The data of this table are extrapolated from the vegetation series map of the Marche Region on a scale of 1:50,000 (Catorci *et al*., 2007) that is not updated since other plant associations have recently been described for the same territory and, in particular, within the class *Molinio-Arrhenatheretea*: such as the associations *Ranunculo neapolitani-Arrhenatheretum elatioris* Allegrezza & Biondi 2011 (Allegrezza & Biondi, 2011) and *Ranunculetum neapolitani-velutini* Lancioni & Taffetani (Lancioni & Taffetani, 2012).

HABITAT CODE	HABITAT DENOMINATION	AREA (HA)	%
3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation	25,97	0,04
6170	Alpine and subalpine calcareous grasslands	8289,45	14,13
6210(*)[1]	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia)(*important orchid sites)	39380,26	67,11
6230*	Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)	997,12	1,7
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	376,26	0,64
-	No EU Habitats	9615,35	16,38
	TOTAL	**58684,41**	**100**

Table 2 - UE Habitats with linear surface and percentage values in which grasslands of the Marche Region representing HNV of excellence can be classified

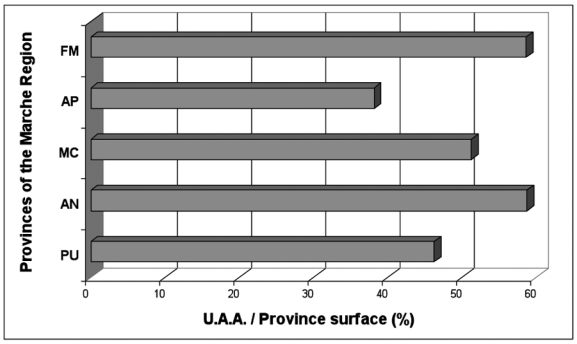

Fig. 4 - U.A.A. Percentage in each Province territories of Marche Region. FM=Fermo; AP= Ascoli Piceno; MC=Macerata; AN=Ancona; PU=Pesaro Urbino. (Data from I.STAT http://dati-censimentoagricoltura.istat.it/ last access on 12/04/2012).

2006, 2008; IEEP, 2007a, 2007b).

The data stored in the geodatabase of the Marche Region (Pesaresi *et al*., 2007) and the performed processing have made possible the agricultural landscape analysis at a cartographic level in order to assess the agro-ecosystemic quality of the investigated area. Phytosociological studies, properly included in computer systems, are a fundamental database from which bio-indicators, suitable to describe the environment in various aspects (Taffetani & Rismondo, 2009), can be synthesized. In fact, landscape diversity and naturalness indices were respectively derived from phytosociological and synphytosociological maps and allowed us to interpret the agro-ecosystem in relation to the choices of the Community policy.

In general, the Marche Region is significantly affected by agricultural and rural environments. Such a situation inevitably reflects on the overall naturalness and diversity degree that are lower in plains and hilly areas and higher in high hills and mountains and in those Provinces where the U.A.A. percentage is greater (fig. 4). Only where there is still a degree of complexity of the environment due to the presence of mosaics of habitats, it is possible to identify the presence of agricultural areas that can still be considered as high natural value ones. The heterogeneity of the landscape becomes a variable that can amplify the quality of the agro-ecosystem even where agricultural practices are more intensive.

Using these parameters, rural areas which cannot be defined as HNV are those portions of the Region that are more artificial because the geomorphological conditions favour the choice of intensive farming practices with high level of production.

In summary, the performed evaluations, although considering only some characteristics of HNV farmlands, allow to highlight the priority objectives in view of management strategies aimed to recover and restore a suitable qualitative state of the agro-ecosystem consistent with the definition of HNV agricultural areas.

References

Allegrezza M. & Biondi E., 2011. Syntaxonomic revision of the Arrhenatherum elatius grasslands of Central Italy. Fitosociologia 48 (1): 23-40.

Angelstamm P., 1992. Conservation of communities: the importance of edges, surroundings, and landscape mosaic structure. In: Hansson L. (Ed.), Ecological principles of nature conservation. Elsevier. London, pp. 9-70.

Andersen E., Baldock D., Bennett H., Beaufoy G., Bignal E., Brouwer F., Elbersen B., Eiden G., Godeschalk F., Jones G., McCracken D., Nieuwenhuizen W., Eupen van M. Hennekens S. & Zervas G., 2003. Developing a high nature value farming area indicator. Internal report. EEA, Copenhagen.

Assessorato alla Tutela e Risanamento Ambientale, 2009. Ambiente e Consumo di Suolo nelle Aree Urbane Funzionali delle Marche. Informazioni inedite e temi per un nuovo governo del territorio http://www.ambiente.regione.marche.it/Portals/0/Informazione/Reporting/2009_atlante_suolo.pdf (last ac-

[1] The recent revision proposed by Biondi & Galdenzi (2012) about the attribution of secondary semi-arid grasslands of central Italian Peninsula to the eastern order *Scorzonero villosae-Chrysopogonetalia grylli,* previously belonging to the order *Brometalia erecti*, could change the allocation of those grasslands from habitat 6210 (*) to 62A0 "Eastern sub-mediterranean dry grasslands (*Scorzoneretalia villosae*)"

cess: 04 December 2012)
Baldock D., 1999. Indicators for High Nature Farming in Europe. In: Brouwer F.M. & Crabtree J.R. (Eds.), Environmental Indicators and Agricultural Policy: 121-135, CAB International.
Baldock D. & Bennett H., 2002. An Introduction to biodiversity and agriculture in Europe. An interim report for EEA and UNEP. IEEP London.
Baldock D., Beaufoy G., Bennett G. & Clark J., 1993. Nature conservation e new directions in the common agricultural policy. IEEP London.
Baldock D., Beaufoy G., Brouwer F. & Godeschalk F., 1996. Farming at the margins: Abandonment or redeployment of agricultural land in Europe. IEEP/LEI-DLO, London/Den Haag.
Beaufoy G. & Marsden K., 2010. CAP Reform 2013 – last chance to stop the decline of Europe´s High Nature Value Farming? Joint position paper by EFNCP, BirdLife International, Butterfly Conservation Europe and WWF (http://www.efncp.org/download/policy-cap-reform-2013.pdf, last access: 04 December 2012).
Bignal E.M. & McCracken D.I., 1996. Low-intensity farming systems in the conservation of the countryside. Journal of Applied Ecology 33: 413-424.
Billeter R., Liira J., Bailey D., Bugter R., Arens P., Augenstein I., Aviron S., Baudry J., Bukacek, R., Burel F., Cerny M., De Blust G., De Cock R., Diekötter T., Dietz H., Dirksen J., Dormann C., Durka W., Frenzel M., Hamersky R., Hendrickx F., Herzog F., Klotz S., Koolstra B., Lausch A., Le Coeur D., Maelfait J.P., Opdam P., Roubalova M., Schermann,A., Schermann N., Schmidt T., Schweiger O., Smulders M., Speelmans M., Simova P., Verboom J., Wingerden Van W., Zobel M. & Edwards P., 2008. Indicators for biodiversity in agricultural landscapes: a pan-European study. Journal of Applied Ecology 45: 141-150.
Biondi E., 1994. The phytosociological approach to landscape study. Ann. Bot. (Roma) 52: 135-141.
Biondi E., 1996. L'analisi fitosociologica nello studio integrato del paesaggio. In "Avances en Fitosociologia": 13-22, Servicio Edit. Universidad del Pais Vasco, Bilbao.
Biondi E., 2011. Phytosociology today: Methodological and conceptual evolution. Plant Biosystems 145 suppl. 1: 19-29.
Biondi E., 2012. Biodiversità, agricoltura, paesaggi e politiche comunitarie. Proposte e Ricerche. Anno XXXV 68: 106-125.
Biondi E. & Colosi L., 2005. Environmental quality: an assessment based on the characters of the plant landscape. Plant Biosystems 139 (2): 145-154.
Biondi E. & Galdenzi D., 2012. Phytosociological analysis of the grasslands of Montagna dei Fiori (central Italy) and syntaxonomic review of the class *Festuco-Brometea* in the Apennines. Plant Sociology, 49 (1): 91-112. doi: 10.7338/pls2012491/05.
Biondi E., Allegrezza M. & Taffetani F., 1988. Dinamismo della vegetazione nell'Appennino tosco e umbro-marchigiano. Proposte e ricerche. Univ. Ancona, Camerino, Macerata, Urbino 20: 29-37.
Biondi E., Burrascano S., Casavecchia S., Copiz R., Del Vico E., Galdenzi D., Gigante D., Lasen C., Spampinato G., Venanzoni R., Zivkovic L. & Blasi C., 2012. Diagnosis and syntaxonomic interpretation of Annex I Habitats (Dir. 92/43/EEC) in Italy at the alliance level. Plant Sociology 49 (1): 5-37. DOI 10.7338/pls2012491/01.
Biondi E., Casavecchia S. & Pesaresi S., 2006. Spontaneous renaturalization processes of the vegetation in the abandoned fields (Central Italy). Ann. Bot. (Roma) 6: 65-93.
Biondi E., Casavecchia S. & Pesaresi S., 2011. Phytosociological synreleve´s and plant landscape mapping: From theory to practice. Plant Biosystems 145 (2): 261-273.
Biondi E., Casavecchia S., Pesaresi S. & Zivkovic L., 2012. Natura 2000 and the Pan-European Ecological Network: a new methodology for data integration. Biodiversity and Conservation 21 (7): 1741-1754. DOI 10.1007/s10531-012-0273-7
Biondi E., Catorci A., Pandolfi M., Casavecchia S., Pesaresi S., Galassi S., Pinzi M., Vitanzi A., Angelini E., Bianchelli M., Cesaretti S., Foglia M., Gatti R., Morelli F., Paradisi L., Ventrone F., & Zabaglia C., 2007. Il progetto di "Rete Ecologica della Regione Marche" (REM): per il monitoraggio e la gestione dei siti Natura 2000 e l'organizzazione in rete delle aree di maggiore naturalità. Fitosociologia 44 (2) suppl. 1: 89-93.
Biondi E., Colantonio R. & Conti G., 2000. I paesaggi contraddittori nella società post-indistriale dall'iper-antropizzazione alla ri-naturazione. In: Biondi E. & Colantonio R. (Eds.), La pianificazione del paesaggio tra ri-naturazione ed iper-antropizzazione. Atti del Convegno - Ancona, 27-28 novembre 1997 - Accademia Marchigiana di Scienze Lettere ed Arti: 7-12.
Blasi C. (Ed.), 2010. La vegetazione d'Italia. Palombi & Partener S.r.l., Roma.
Blasi C. (Ed.), 2010. La vegetazione d'Italia. Carta delle serie di vegetazione, scala 1:500.000". Palombi & Partener S.r.l., Roma.
Blasi C., Biondi E. & Izco J., 2011. 100 years of plant sociology: A celebration. Plant Biosystems 145 suppl. 1: 1-3.
Blasi C. & Frondoni R., 2011. Modern perspectives for plant sociology: The case of ecological land classification and the ecoregions of Italy. Plant Biosystems 145 suppl. 1: 30-37.
Brouwer F.M., Baldock D. & La Chapelle C. (Eds.), 2001. The relation between agriculture and nature

management. High level conference on EU enlargement, Wassenaar, 22–24 January 2001.

Catorci A., Biondi E., Casavecchia S., Pesaresi S., Vitanzi A., Foglia M., Galassi S., Pinzi M., Angelini E., Bianchelli M., Ventrone F., Cesaretti S. & Gatti R., 2007. La Carta della Vegetazione e degli elementi di paesaggio vegetale delle Marche (scala 1:50000) per la progettazione e la gestione della rete ecologica regionale. Fitosociologia 44 (2) suppl. 1: 115-118.

CEC, 2000. Indicators for the integration of environmental concerns into the common agricultural policy. Communication from the Commission to the Council and the European Parliament COM(2000) 20 final. CEC, Brussels.

COM(2000) 20 definitivo - Comunicazione della Commissione al Consiglio e al Parlamento Europeo – Indicatori per l'integrazione della problematica ambientale nella politica agricola comune.

COM(2003) 62 definitivo - Comunicazione della Commissione al Consiglio e al Parlamento Europeo – Cooperazione ambientale paneuropea dopo la conferenza di Kiev del 2003.

Dwyer J., Baldock D., Beaufoy G., Benett H., Lowe P. & Ward N., 2002. Europe's rural futures. The nature of rural development II, pp. 24.

Edwards P.J., Kollmann J. & Wood D., 1999. The agroecosystem in the landscape: implications for biodiversity and ecosystem function. In Wood D. & Lenné J.M. (Eds.), Agrobiodiversity: Characterization, Utilization and Management: 183-210. CAB International, Wallingford, UK.

EEA, 2001. Environmental Signals. Environmental assessment report No 8. EEA, Copenhagen. EEA (2004). Agriculture and the environment in the EU accession countries. Implications of applying the EU common agricultural policy. Environmental issue report No 37. EEA, Copenhagen.

EEA, 2004. High nature value farmland: Characteristics, trends and policy challenges. Luxembourg: Office for Official Publications of the European Communities. 32 pp. ISBN 92-9167-664-0

Forconi V., 2007. Aree agricole ad alto valore naturalistico: individuazione, conservazione, valorizzazione. In: APAT (Ed.), Aree agricole ad alto valore naturalistico: individuazione, conservazione, valorizzazione. Atti Convegno, Roma, 21 giugno 2007.

Galdenzi D., Pesaresi S., Colosi L. & Biondi E., 2011. Methodological aspects for the evaluation of the quality of agro-ecosystems and landscapes that give rise. Fitosociologia 48 (2): 65-76.

Géhu J.-M., 1988. L'analyse symphytosociologique et géosymphytosociologique de l'espace. Théorie et méthodologie. Colloq. Phytosoc. 17: 11-46.

Géhu J-M., 2006. Dictionnaire de Sociologie et Synecologie végétales. Berlin-Stuttgart: J Cramer. p. 900.

Géhu J.-M. & Rivas-Martinez S., 1981. Notions fondamentales de phytosociologie. Ber. Int. Symp. Ver. Vegetationskunde: 5-33.

Hellegers, P.J.G.J. & Godeschalk F.E., 1998. Farming in high nature value regions. The role of agricultural policy in maintaining HNV farming systems in Europe. Onderzoeksverslag 165. LEI-DLO, Wageningen.

Hoogeveen Y.R., Petersen J.E. & Gabrielsen P., 2001. Agriculture and biodiversity in Europe. Background report to the High-Level European Conference on Agriculture and Biodiversity, 5–7 June, Paris. STRA-CO/AGRI (2001) 17. Council of Europe/ UNEP.

IEEP, 2007a. Final report for the study on hnv indicators for evaluation. Report prepared for the EU-Commission, DG. Agriculture, October 2007, 190 pp.

IEEP, 2007b. HNV Indicators for Evaluation, Final report for DG Agriculture. Contract Notice 2006-G4-04.

IEEP, 2008. Guidance Document to the Member States on the Application of the High Nature Value Indicator. Report for DG Agriculture.

ISPRA, 2010. Aree agricole ad alto valore valore naturale: dall'individuazione alla gestione. Manuale e linee guida. N. 62. Roma.

Kabourakis E., 1999. Code of Practices for Ecological Olive Production Systems in Crete. Olivae 77: 46 - 55. International Olive Oil Council, Madrid.

Kleijn D. & Sutherland W.J., 2003. How effective are European agri-environment schemes in conserving and promoting biodiversity? Journal of Applied Ecology 40 (6): 947-969. British Ecological Society.

Kosmas C., Yassoglou N., Kounalaki A. & Kairis O., 2008. Land abandonment, Desertification processes, LUCINDA – Land Care in Desertification Affected Areas: From Science towards Application, 6th FrameworkProgramme, European Union. Booklet series B4: 1-16.

Krebs J.R., Wilson J.D., Bradbury R.B. & Siriwardena G.M., 1999. The second silent spring? Nature 400: 611-612.

Kristensen, P., 2003. EEA core set of indicators: revised version April 2003. Technical report. EEA, Copenhagen.

Lancioni A. & Taffetani F., 2012. Vegetation of mowed and trampled habitats of a rural hilly area (Marche Region - central Italy). Plant Sociology 49 (1): 55-80.

Lawton J. H. & May R. M. (Eds.), 1995. Extinction Rates. Oxford University Press, Oxford. xii + 233.

MacDonald D., Crabtree J.R., Wiesinger G., Dax T., Stamou N., Fleury P, Lazpita J.G. & Gibon A., 2000. Agricultural abandonment in mountain areas of Europe: environmental consequences and policy response. J Environ Manage 59: 47-69

Plachter H., 1996. A Central European approach for the protection of biodiversity. In: Ogrin, D. (Ed.), Nature conservation outside protected areas: 91-108. Conf. Proc. Ministry Environm. and Phys. Planning. Ljubljana

Plachter H., 1998. A central European contribution to a pan-European conservation strategy. La Canada 10. EFNCP

Paracchini M. L., Petersen J-E., Hoogeveen Y., Bamps C., Burfield I. & Swaay van C., 2008. High Nature Value Farmland in Europe. An Estimate of the Distribution Patterns on the Basis of Land Cover and Biodiversity Data. European Commission Joint Research Centre, Institute for Environment and Sustainability. Office for Official Publications of the European Communities, Luxembourg.

Paracchini M.L., Terres J.M., Petersen J.E. & Hoogeveen Y., 2006. Background Document on the Methodology for Mapping High Nature Value Farmland in EU27. European Commission Directorate General Joint Research Centre and the European Environment Agency.

Pesaresi S., Biondi E., Casavecchia S., Catorci A. & Foglia M., 2007. Il Geodatabase del Sistema Informativo Vegetazionale delle Marche. Fitosociologia 44 (2) suppl. 1: 95-101.

Plieninger T., Hochtl F., & Spek T., 2006. Traditional land-use and nature conservation in European rural landscapes. Environ Sci Policy 9: 317-321.

Regolamento (CE) n.1698/2005 del Consiglio 20 settembre 2005. EEA - Joint Researche Centre, Ottobre 2006. Background document on the methodology for mapping high nature value farmland in EU27.

Rismondo M., Lancioni A. & Taffetani F., 2011. Integrated tools and methods for the analysis of agro-ecosystem'sfunctionality through vegetational investigations. Fitosociologia 48 (1): 41-52.

Rivas-Martínez S., 2005. Notions on dynamic-catenal phytosociology as a basis of landscape science. Plant Biosystems 139: 135-144.

Robinson R. & Sutherland W.J., 2002. Post-war changes in arable farming and biodiversity in Great Britain. Journal of Applied Ecology 39: 157-176.

Simpson E. H., 1949. Measurement of diversity. Nature 163: 688

Stoate C., Baldi A., Beja P., Boatman N.D., Herzon I., van Doorn A., de Snoo G.R., Rakosy L. & Ramwell C., 2009. Ecological impacts of early 21st century agricultural change in Europe—a review. J Environ Manage 91:22–46.

Taffetani F. & Rismondo M., 2009. Bioindicator system for the evaluation of the environmental quality of agro-ecosystems. Fitosociologia 46 (2): 3-22.

Theurillat J.P., 1992. Etude et cartographie du paysage végétal (symphytosociologie) dans la Région d'Aletsch (Valais, Suisse). 2 vols. Centre alpin de phytogéographie. Champex et Conservatoire et Jardin botaniques de la ville de Genève, Krypto, Teufen. Tüxen R., 1978. Assoziationskomplexe (Sigmeten). Ber. Intern. Symposion, 1977, in Rinteln.

Tubbs C.R., 1997. A Vision for Rural Europe. British Wildlife 9: 79-85.

Tucker G.M. & Heath M.F., 1994. Birds in Europe. Their conservation status. Birdlife Conservation Series No 3. Birdlife International, Cambridge.

Tüxen R., 1978. Assoziationskompleze (SIgmeten). Ber. Intern. Symposium, 1977, in Rinteln.

UN/ECE, 2003. Kyiv resolution on biodiversity. Fifth Ministerial Conference 'Environment for Europe', Kyiv, Ukraine, 21–23 May 2003. Document ECE/CEP/108. United Nations, Economic Commission for Europe.

Wilcox B.A. & Murphy D.D., 1985. Conservation strategy: the effects of fragmentation on extinction. Am.Nat. 125: 879-887.

Zivkovic L., 2009. Analisi fitosociologiche e geosinfitosociologiche per la realizzazione delle reti ecologiche: il caso studio della Provincia di Ancona. Università Politecnica delle Marche, Doctoral Thesis, 2008/2009.