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THE GRAZING AGRI-ECOSYSTEM OF MOUNTS ROGEDANO-PURO (MARCHES REGION, CENTRAL ITALY): PRELIMINARY RESULTS OF A MULTIDISCIPLINARY STUDY

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Abstract: The present work offers the first results of a study about the grazing ecosystem of Mounts Rogedano and Puro (Marches Region, central Italy), using phytosociological data as a point of departure. In particular, it describes the area's historical and geomorphological characteristics and provides an initial characterization of the soils that distinguish the territory. Thus the results of inquiries into the horizontal and vertical structure are presented, as well as those concerning productivity in terms of phytomass and the nutritional value of the grazing vegetation. Finally, the morpho-functional characteristics of the digestive system of cattle and sheep are considered, in the effort to provide an initial multidisciplinary analysis of the ecosystem and its productivity for zootechnical purposes.

Introduction

Taking as a starting point the phytosociological data reported in "Geobotanical aspects and historical-environmental features of the Upper Esino - Umbria and Marches Appenines" [4] a study, the preliminary results of which are presented here, was initiated to examine the ecology and the productivity potential of the grazing agro-ecosystem of Mounts Rogedano and Puro. The goal in doing so was to assess the use of a multidisciplinary approach in defining management basics for the Apennine mountain pastures, aimed at conserving the biodiversity of this important ecosystem.

Materials and Methods

This study is based on the analysis and correlation of the following aspects: history of the land use; geomorphology and pedology; phytosociology; vegetation structure, productivity and grazing value, anatomy of the digestive tract of domestic herbivores that use these pastures, and preliminary correlations with the vegetation structure. In order to obtain these results a survey was conducted from May to October 2003, using the methods described at the beginning of each section.

Territorial and bioclimatic setting

The study area covers the summit zone of Mount Rogedano (917 m) and Mount Puro (1155 m), two calcareous mountain ranges situated in the central-western Marches Region (Fig. 1), from which arises a small ridge oriented from northwest to southeast. From a morphological point of view, in the northern sector (M. Rogedano) the summits are moderately steep, with broad areas of flat land, while in the southern sector (M. Puro) the slopes are more steep; south of the peak of M. Puro, finally, there is an asymmetric crest (Costa del Puro) that forms a steep rocky escarpment, 60-70 m high, at the foot of which spreads out a broad detritic band.

Fig. 1: Study area (•)

In terms of climate [30, 6], this territory belongs to the semioceanic temperate region with upper hilly thermotype and, above 1000 m approximately, lower montane (the average annual T is 10-11°C); the ombrotype is of the lower humid kind, with precipitation (900-1100 mm/year) that presents a Mediterranean type regime with autumnal and springtime maximums and a strong fall in the summer (180-200 mm). The mesoclimate, however, is not marked by arid periods, but on the southern slopes and in the zones with shallow soils (lithosoils) there are long phases with a negative hydric balance (Catorci, Pieruccini and Gafta, work in progress). Vegetative activity begins in the first half of the month of April, when the average daily T stably exceeds 6°C, ending between the end of October and the first half of November, when the first autumnal freezes begin. During the winter snow covers the summits only occasionally and for brief periods.

Geomorphological and pedological aspects

The ridge of Mounts Rogedano and Puro is located in the north-central sector of the Umbria-Marches mountain chain, a thrust-fold belt made of the Cretaceous-Paleogene mainly calcareous rocks belonging to the Umbria-Marches Sequence [14]. The outcropping formations are maiolica (white limestone and flint), marne a fucoidi (marls, calcareous marls), scaglia bianca (white limestones and flint) and scaglia rossa (reddish limestones and marly limestones with flint). The landscape is characterised by deep valleys with very steep slopes and broad, almost flat summits, incised by U-shaped valleys with gentle local slopes. These features are the remnants of an old landscape modelled at the sea level during the Early Pliocene at the beginning of the uplift of the Apennine Chain (Planation Surface) [15]. Later, the Planation Surface underwent to dissection due to tectonics (increasing uplift) and to climate (Quaternary glaciations) by means of gravity and fluvial processes (active today) and crio-nival and glacial process (inactive).

During the Interglacials (warm and humid conditions), dense forests covered the slopes [21] of the calcareous Apennines and thick rubefied, decalcified and argillaceous soils were formed (paleosoils) whereas during the Glacials (cold and arid conditions) the slopes were bared and subjected to strong degradational and soil erosion processes resulting in thin and calcareous soils [16]. The colluviation of Interglacial soils locally gives acid characteristic to the present-day soils, strongly influencing the vegetation cover [9, 29]. During the Holocene, anthropic activities (agriculture, grazing, urban settlements, infrastructures etc.) led to important changes in the presence and distribution of the vegetation cover and therefore of the soilscape, resulting in

the degradation of the soil characteristics, preventing the formation of soils similar to those of the Last Interglacial [17, 37].

In the study area, 5 soil profiles have been made in different vegetational and morphological contexts, since morphology is the major factor that influences soil preservation and its sensitivity to run-off and gravitational erosional processes. In general, the gentler morphologies host thin soils that reach the maximum thickness (ca. 30 cm) whereas on the steeper slopes lithosoils are present. The bedrock is made of limestones or calcareous debris talus. The soils show few developed profiles, AC-like, with very thin O horizons and blackish-brown partially decalcified humic A1 horizons. Greyish colours, due to more difficult internal drainage and/or to agricultural practices, have locally been observed. A thin Bt reddish brown horizon is present in the soil profile located on the flattener morphology, possibly due to the preservation of colluviated paleosoils.

On the whole, they are rendzina-like humiferous soils [20] or humic Mollisols [34, 35]. Further investigations and chemical-physical analysis are still ongoing, aimed at better characterisation of the soil profiles.

Historical evolution of the landscape and current use of the grazing lands

The current plant landscape of this montane sector resembles the typical Apennine one in which agricultural crops are concentrated for the most part in the piedmont areas, while woods cover the flanks of the ridges; the grazing lands, instead, prevalently cover the summit domes of the ranges above 800 m. Thus, as demonstrated for other Apennine zones [11, 24], it can be hypothesized that the grazing ecosystems of the Monte Rogedano-Puro area were obtained as early as in the Neolithic, through burning of the primordial forests.

In the Roman epoch, while the piedmont strip passed from remote forests and bogs to agriculture, the high altitude Apennine lands remained "*ager publicus* (public lands)", reserved for greazing herds. The latter were connected to the Roman Serradica-Matelica livestock trail, which joined at the foot of Monte Puro with the shepherd's footpaths directed towards the Roman bridges of the "Prolaquense Road" [4].

The ancient practice of the transhumance continued during the middle ages as well [22], as confirmed by the presence of an area destined exclusively for grazing defined as "*Mons Lentinus*", the perimeter of which was indicated in a 1322 land register (Fig. 2).

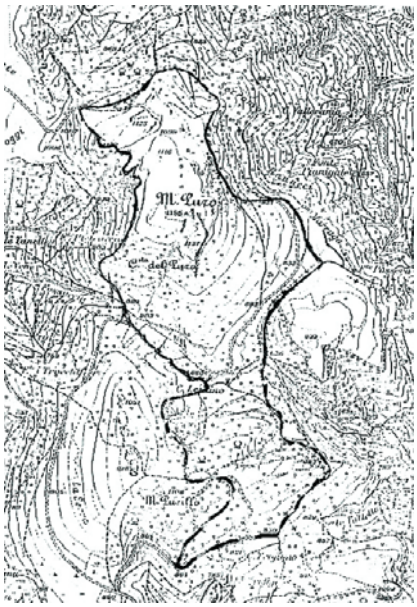


Fig. 2: The Lentino grazing land. Hypotetical borders based on land register records from 1322 (Historical Archive of the Fabriano City, land register record n. 36)

Later, in a XVII sec. engraving of the Fabriano district are pointed out the "Rogedano meadows" and "Puro meadows" place-name [5].

Even a quick analysis of the data of the Gregorian Land Register of the mid XIX century, shows that all the land register lots located in the summit area of Mounts Rogedano and Puro are indicated as "natural meadows" thus demonstrating the ongoing presence over the course of the centuries of a landscape dedicated to livestock grazing.

In the mid 1930's, instead, in line with the Fascist regime's autarky (a policy aimed at economic self-sufficiency), the less steep surfaces at the edges of the Rogedano grazing lands were tilled and cultivated with the system of three-year crop rotation, so that the range came to be called by residents "Gold Mountain".

One can thus affirm that in the grazing land phytocoenoses of this montane sphere, unlike those in other mountainous complexes of the Umbria-Marches Apennines [8], there has been a substantial ecological continuity from Roman times to date, in fact, quite probably, since the Neolithic.

However, beginning in the mid-twentieth century, the grazing lands of the zone have been less utilized because of the decline of the silvicultural and pastoral economy, which has provoked a considerable reduction in herds, accompanied by an analogous reduction in the population residing in the piedmont centers (Tab. 1).

Table 1: Zootechnological patrimony and demographic rate in the rural centers of the montane land of the Fabrianao area

	1951	**1958**	**1970**	**1974**	**1978**	**1990**	**2000**
Ovine	25920	10358	5541			5662	3711
Bovine	5358	5446	4371	3832	3400	1582	1313
Man	2894				1743		1736

Currently the presence of sheep and cattle continues to diminish, with a more accentuated rate for sheep. The latter are located in the grazing lands of Monte Puro-Lentino, with a flock of about 150-200 sheep, though its presence has not been constant over the years. Cattle and horses, instead, are concentrated in the Rogedano area, with herds in the tens and twenties that are brought to the summit grazing lands after June mowing, which provides hay for the stalls at the bottom of the valley. In contrast, on Monte Puro no haymaking has been done in in the last twenty years.

Syntaxonomy and syndynamics

The herbaceous vegetation of the study area has been identified for the following *syntaxa* (Tab. 2).

Asperulo purpureae-Brometum erecti - Xeric grazing land, prevalently of *Bromus erectus,* with an open turf, that allows rocky substrata to appear extensively; it occupies the southern slopes with average steepness, on both "Scaglia rosata" and "Maiolica", covered by lithosoils.

Brizo mediae-Brometum erecti – Semimesophilous grazing land, prevalently of *Bromus erectus*, with dense and polyphytic turf; it occupies vast areas on not very steep slopes, with northern exposure, both on "Scaglia rosata" and "Maiolica", covered by rendzinas.

Brizo mediae-Brometum erecti danthonietosum alpinae - Mesophylous and subacidophilous meadows, prevalently of *Bromus erectus* and *Agrostis capillaris*; with a dense and polyphytic turf; it occupies the summit areas of Monte Rogedano exclusively, where there are argillificated paleosoils at subacid ph.

Table 2: Vegetation of the summit grazing lands of Mounts Rogedano and Puro

N° relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Exposure	ESE	ENE	WSW	NE	WNW	SE	N	W	N	NE	N	N	W	SW	S	S	S	SE	SE	S
Slope (%)	35	15	10	5	2	2	2	8	2	2	5	15	3	15	45	50	45	55	55	65
Cover (%)	95	100	95	100	100	100	100	100	100	100	100	100	95	100	95	90	90	95	95	90
Surface (m^2)	100	100	200	150	100	150	120	100	100	100	100	50	75	100	100	100	100	150	150	150
Altitude (m)	790	720	550	880	860	820	920	920	1100	1120	1100	1110	1120	1100	1090	1120	1100	1160	1200	1200
Sp. Caract. of ***Asperulo purpureae-Brometum erecti***																				
Asperula purpurea ssp. *purpurea*	2	1	1	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+
Eryngium amethystinum	+	1	+	+	.	1	+	+	.	+	+	.	+	1	1	+	+	1	+	+
Crepis lacera	+	+	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	1	+	+
Allium sphaerocephalon ssp. *sphaerocephalon*	.	+	.	.	.	.	.	+	+	.	.	+	+	+	+	.	.	1	+	+
Dianthus ciliatus ssp. *ciliatus*	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sp. Caract. and diff.* of ***Brizo mediae-Brometum erecti***																				
Briza media ssp. *media*	.	.	+	1	1	2	1	2	1	1	+	+	.	.	.	.	.	.	.	.
*Leontodon cichoraceus**	.	.	.	+	+	1	+	+	+	.	+	+	.	.	+	.	+	.	.	.
Filipendula vulgaris	.	.	.	.	+	1	2	+	3	2	+	1	.	2	.	.	.	.	.	.
Stachys officinalis ssp. *officinalis**	.	.	.	.	+	+	+	1	1	1	.	+	.	.	.	.	.	.	.	+
Centaurea triumfetti ssp. *aligera*	.	.	.	.	+	.	.	+	.	+	1	+	.	.	+	.	.	.	.	+
Plantago lanceolata var. *lanceolata*	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula multiflora ssp. *multiflora*	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sp. diff. of ***Danthonietosum alpinae***																				
Cynosurus cristatus	.	.	.	+	2	3	2	2	.	.	.	.	.	.	.	.	.	.	.	.
Danthonia alpina	.	.	.	.	+	2	+	2	.	+	.	.	.	.	.	.	.	.	.	.
Agrostis capillaris	.	.	.	.	.	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.
Sp. diff. of ***Trifolietosum montani***																				
Trifolium montanum ssp. *rupestre*	.	.	.	+	+	1	+	1	2	2	2	1	.	+	.	.	.	.	.	.
Senecio doronicum ssp. *gerardii*	.	.	.	+	.	.	.	1	+	+	1	+	.	.	.	.	.	.	.	.
Pedicularis comosa	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.
Sp. of ***Sesleria tenuifolia* and *Stipa dasyvaginata* ssp. *apenninicola* aggr.**																				
Stipa dasyvaginata ssp. *apenninicola*	.	.	.	.	.	.	.	.	.	.	.	.	2	3	2	1	1	+	1	.
Carex humilis	.	.	.	.	.	.	.	.	.	3	1	.	.	+	1	1	2	1	1	1
Sesleria tenuifolia ssp. *tenuifolia*	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	4	4	4	4	4
Scorzonera austriaca (s.l.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+
Onobrychis alba ssp. *alba*	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	+	.	+	+	.
Echinops ritro ssp. *ruthenicus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1
Sp. Caract. of ***Phleo ambigui-Bromion erecti***																				
Koeleria lobata	1	.	+	+	+	.	+	+	+	+	1	1	+	+	+	+	+	+	+	+

Galium corrudifolium	+	+	+	+	1	.	+	+	1	2	1	1	1	+	+	+	+	+	.	.
Centaurea ambigua ssp. *ambigua*	.	1	.	+	1	1	+	+	1	+	+	+	.	+	+	.	.	+	.	+
Helictotrichon versicolor ssp. *praetutianum*	+	.	.	+	.	+	+	1	+	+	+	1	.	.	+	.	.	.	.	.
Muscari neglectum	+	.	.	+	+	.	.	+	.	.	+	+	+	+	+	.	.	.	.	.
Erysimum pseudoraethicum	+	+	+	.	.	.	.	.	+	.	.	+	1	.	.	+	+	+	+	+
Centaurea rupestris (s.l.)	.	.	.	.	.	.	.	.	.	+	.	+	+	2	1	1	1	+	+	1
Phleum ambiguum	+	+	+	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	+	+
Helianthemum oelandicum ssp. *incanum*	+	.	.	.	.	.	.	.	.	.	.	.	2	.	2	+	+	1	1	1
Silene otites ssp. *otites*	+	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	+
Polygala major	.	.	.	.	.	.	.	.	.	1	+	+	+	.	.	.	.	.	.	.
Thymus striatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	1
Festuca circummediterranea	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Hieracium piloselloides ssp. *piloselloides*	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sp. Caract. of ***Artemisio albae-Bromenalia erecti***																				
Potentilla rigoana	.	.	.	+	+	+	+	+	.	1	+	.	.	.	.	.	.	.	.	.
Linum tenuifolium	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	+
Thesium divaricatum	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.
Teucrium montanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	1
Helichrysum italicum ssp. *italicum*	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Coronilla minima ssp. *minima*	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Dianthus sylvestris ssp. *longicaulis*	.	.	+	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.
Petrorhagia saxifraga ssp. *saxifraga*	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Ononis pusilla	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Globularia punctata	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Sp. Caract. of ***Brometalia* and *Festuco-Brometea***																				
Bromus erectus ssp. *erectus*	2	4	4	3	3	2	3	3	3	2	1	4	.	3	1	+	+	1	+	2
Knautia purpurea	+	1	.	+	+	1	1	+	2	1	+	+	+	+	.	+	+	+	+	+
Helianthemum nummularium ssp. *obscurum*	1	1	+	+	.	+	1	+	1	1	1	+	.	.	+	1	1	1	2	.
Festuca laevigata ssp. *laevigata*	1	2	.	.	2	.	2	2	2	+	2	2	2	2	1	1	1	1	1	2
Trinia cfr dalechampi	+	1	.	+	+	.	.	+	.	+	1	.	1	2	1	+	+	+	+	+
Teucrium chamaedrys ssp. *chamaedrys*	+	1	1	+	.	.	+	+	.	.	+	.	+	+	+	.	+	+	+	+
Linum bienne	.	.	.	+	1	+	+	+	.	.	.	.	.	+	+	+	+	+	+	+
Sanguisorba minor ssp. *balearica*	+	+	+	1	+	+	.	+	.	+	+	.	+	1	+	+	+	+	.	.
Hieracium pilosella ssp. *trichosoma*	1	+	+	+	+	.	+	.	.	+	.	+	.	.	+	+	+	.	.	+
Anthyllis vulneraria ssp. *polyphylla*	.	.	+	.	+	.	.	+	.	+	+	.	1	+	.	+	1	1	+	+
Onobrychis viciifolia	2	+	+	1	2	1	1	1	+	+	.	.	.	.	.	.	.	.	.	.
Trifolium ochroleucon	+	+	1	+	+	+	+	+	1	.	+	.	.	.	.	.	.	.	.	.
Trifolium campestre ssp. *campestre*	+	.	+	1	1	+	+	+	.	.	.	.	.	+	+	.	.	.	.	.
Anacamptis pyramidalis	1	+	+	+	.	.	+	+	.	+	1	.	+	.	.	.	+	.	1	.
Rhinanthus minor	+	.	.	3	1	2	+	1	.	.	+	+	.	+	.	.	.	.	.	.
Ranunculus bulbosus ssp. *aleae*	.	.	+	+	1	1	1	+	+	.	.	.	.	.	.	.	.	.	.	.
Dianthus carthusianorum (s.l.)	.	.	+	.	1	+	+	+	+	+	+	1	.	.	.	.	.	.	.	.
Orchis morio ssp. *morio*	+	+	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.

Plantago lanceolata var. *sphaerostachya*	+	+	+	+	+	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.
Brachypodium rupestre	+	1	1	+	.	.	1	+	.	.	.	.	+	+	.	.	.	.	.	.
Cerastium arvense ssp. *suffruticosum*	.	.	.	.	+	.	.	.	.	.	.	.	+	.	+	.	.	+	+	+
Thymus praecox ssp. *polytrichus*	1	.	+	.	.	.	.	+	.	.	.	.	+	1	1	.	.	.	.	.
Stachys recta ssp. *recta*	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	+	+
Trifolium incarnatum ssp. *molinerii*	+	.	.	+	2	2	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Linum catarthicum ssp. *catarthicum*	+	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Euphrasia stricta	.	.	.	+	+	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.
Thymus longicaulis ssp. *longicaulis*	.	+	.	+	+	.	+	.	.	.	.	.	1	1	.	.	.	.	.	.
Dactylorhiza sambucina	.	.	.	+	.	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.
Orchis mascula ssp. *mascula*	.	.	.	+	.	.	+	+	.	+	+	.	.	+	+	.	.	.	.	.
Carex caryophyllea ssp. *caryophyllea*	+	.	.	+	.	.	+	+	1	.	.	+	.	+	.	.	.	.	.	.
Leontodon hirtus	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	+	+
Plantago argentea	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	+	.	+	+	+
Salvia pratensis ssp. *pratensis*	.	.	.	1	1	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Luzula campestris ssp. *campestris*	.	.	.	+	.	+	+	1	.	+	.	+	.	.	.	.	.	.	.	.
Asperula cynanchica	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.
Carlina acanthifolia ssp. *acanthifolia*	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	.
Saxifraga bulbifera	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Leucanthemum vulgare (s.l.)	.	.	+	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Asphodelus macrocarpus ssp. *macrocarpus*	.	.	.	.	+	.	.	.	+	+	.	+	.	.	+	.	.	.	.	.
Ononis spinosa ssp. *spinosa*	1	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla acaulis ssp. *arenaria*	+	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.
Dianthus sylvestris ssp. *sylvestris*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	1	1
Gymnadenia conopsea ssp. *conopsea*	.	.	.	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Polygala nicaeensis ssp. *mediterranea*	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunella laciniata	+	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Scabiosa columbaria (s.l.)	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Alyssum campestre ssp. *campestre*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+
Anthyllis montana ssp. *atropurpurea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+
Arabis hirsuta	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthyllis vulneraria ssp. *rubriflora*	.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Armeria canescens ssp. *canescens*	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Medicago lupulina	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Peucedanum oreoselinum	.	.	.	.	.	.	.	.	+	.	2	+	.	.	.	.	.	.	.	.
Hippocrepis comosa	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthemum apenninum ssp. *apenninum*	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+
Orchis ustulata	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Chamaecytisus hirsutus ssp. *polythricus*	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.
Thesium linophyllon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1
Sp. transgr. by ***Seslerietalia*** **and** ***Elyno-Seslerietea***																				
Carex macrolepis	.	.	.	.	.	.	.	.	.	1	4	3	+	+	+	.	.	.	.	.
Sempervivum tectorum ssp. *schottii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	+	+
Valeriana tuberosa	.	.	.	.	+	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.

Sp. Caract. of ***Cynosurion cristati***																				
Lolium perenne	.	.	.	+	1	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium repens ssp. *repens*	.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Sp. Caract. of ***Arrhenatheretalia* and *Molinio-Arrhenatheretea***																				
Anthoxanthum odoratum	.	.	.	1	1	2	1	1	.	+	.	1	.	+	.	.	.	+	+	.
Bellis perennis	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylis glomerata ssp. *glomerata*	+	+	1	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Lotus corniculatus	1	+	.	1	1	1	+	+	.	.	.	+	.	+	+	.	.	.	.	+
Centaurea jacea ssp. *gaudini*	.	+	+	1	+	1	1	+	1	1	+	+	.	.	.	.	.	.	.	.
Leontodon hispidus ssp. *hispidus*	.	.	.	+	.	+	+	+	+	+	+	.	.	.	+	.	.	.	.	.
Bromus hordeaceus ssp. *hordeaceaus*	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bunium bulbocastanum ssp. *bulbocastanum*	+	.	+	+	.	+	+	+	.	.	.	.	.	.	+	.	.	+	.	.
Rumex acetosa ssp. *acetosa*	.	.	.	.	.	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.
Trifolium pratense ssp. *pratense*	.	.	.	.	2	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Companion species																				
Tanacetum corymbosum	+	+	.	+	.	.	.	+	+	1	.	.	1	+	1	.	+	+	+	+
Bupleurum baldense ssp. *baldense*	+	+	+	.	.	.	+	+	.	.	.	.	.	.	.	+	.	+	+	+
Aira caryophyllea ssp. *caryophyllea*	+	.	.	2	1	+	+	+	.	.	.	.	.	+	.	.	.	+	.	.
Inula hirta	.	.	.	.	.	+	.	+	+	2	+	+	+	.	+	.	+	.	+	.
Sedum rupestre ssp. *rupestre*	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+
Sherardia arvensis	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Campanula rapunculus ssp. *rapunculus*	+	.	+	.	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium scabrum	+	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala vulgaris ssp. *vulgaris*	.	.	.	.	+	.	.	1	+	+	.	+	.	.	.	.	.	.	.	.
Sedum sexangulare	.	+	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Cynosurus echinatus	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Ferulago campestris	.	.	.	.	.	1	.	+	.	.	.	.	+	.	1	.	.	.	.	.
Laserpitium siler var. *siculum*	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	+	.
Sedum acre	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.
Ranunculus millefoliatus	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leucanthemum adustum	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Lathyrus sylvestris ssp. *sylvestris*	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aira elegantissima	+	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Plantago holosteum ssp. *holosteum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	1	.
Cachrys ferulacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Chance species	5	6	4	2	5	4	1	1	2	2	1	2	2	1	0	2	0	3	2	3

Legend: Rel. 1-3: *Asperulo purpureae-Brometum erecti*; Rel. 4: *Brizo mediae-Brometum erecti*; Rel. 5-8: *Brizo mediae-Brometum erecti danthonietosum alpinum*; Rel. 9-12: *Brizo mediae-Brometum erecti trifolietosum montani*; Rel. 13-20: aggr. *Sesleria tenuifolia* and *Stipa dasyvaginata* ssp. *apenninicola*

Brizo mediae-Brometum erecti trifolietosum montani - Semimesophilous meadows, prevalently of *Bromus erectus*, with fairly dense but not very species-rich turf; it occupies the slopes of average steepness with northern exposure, on Monte Puro. The soil is composed of rendzina with a structure that is very rich in sand.

Aggr. of *Sesleria tenuifolia* and *Stipa dasyvaginata* ssp. *apenninicola* - A discontinuous meadows with a "terraced" structure and fairly low average cover, physionomically distinguished from *Sesleria tenuifolia*, which develops on the crests or on the slopes where there are constant processes of detritus accumulation from the rocky walls above; vegetation developed on lithosoils partially covered by mobile calcareous detritus.

From the dynamic point of view, the grazing lands in the study area belong to three vegetation series.

1. *Scutellario columnae-Ostryeto carpinifoliae* sigmetum - *Scutellario columnae-Ostryetum carpinifoliae* (Laburno-Ostryenion-Ostryo-Carpinion orientalis); *Spartio juncei-Cytisetum sessilifolii* (Cytision sessilifolii); *Asperulo purpureae-Brometum erecti* and Aggr. of *Sesleria tenuifolia* and *Stipa dasyvaginata* ssp. *appenninicola* (Phleo ambigui-Bromion erecti).

2. *Carici sylvaticae-Querceto cerridis* sigmetum - *Carici sylvaticae-Quercetum cerridis* (Pulmonario apenninae-Carpinenion betuli-Erythronio-Carpinion betuli); *Cytiso sessilifolii-Crataegetum laevigatae rosetosum arvensis* (Ribeso alpinii-Juniperenion communis-Berberidion vulgaris); *Brizo mediae-Brometum erecti danthonietosum alpinae* (Phleo ambigui-Bromion erecti).

3. *Lathyro veneti-Fageto sylvaticae* sigmetum - *Lathyro veneti-Fagetum sylvaticae* (Lathyro veneti-Fagenion sylvaticae–Geranio versicoloris-Fagion sylvaticae); *Rosetum pimpinellifoliae* (Berberidion vulgaris); *Brizo mediae-Brometum erecti* and *Brizo mediae-Brometum erecti trifolietosum montanae* (Phleo ambigui-Bromion erecti).

Horizontal and vertical vegetation structure

The horizontal and vertical distribution of plants, in addition to being a characteristic element of every plant association [2], also takes on a certain importance for zootechnical purposes, because it influences anthropic activities such as mowing [32] as well as the herbivores greazing beheaviour [28].

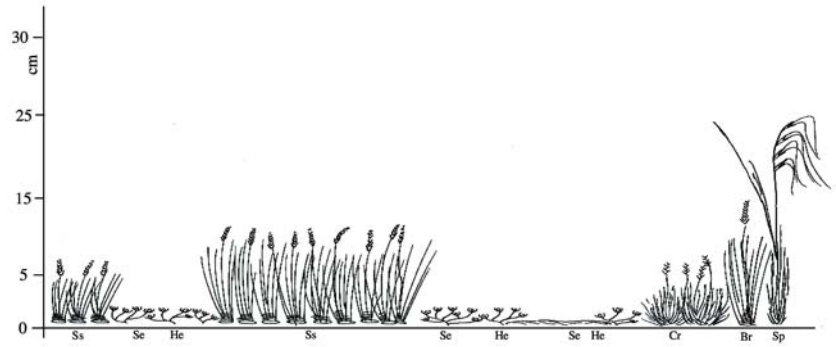
Thus it was considered useful to ascertain this structural datum; to this end, 10 linear transects were done with the method proposed by Donita, Ivan and Pedrotti [19].

These were then averaged, in order to obtain a model of the horizontal and vertical structure of each of the five *syntaxa* studied. The charts thus produced (Fig. 3) show some notable differences both for density and for the way the plant species consociate.

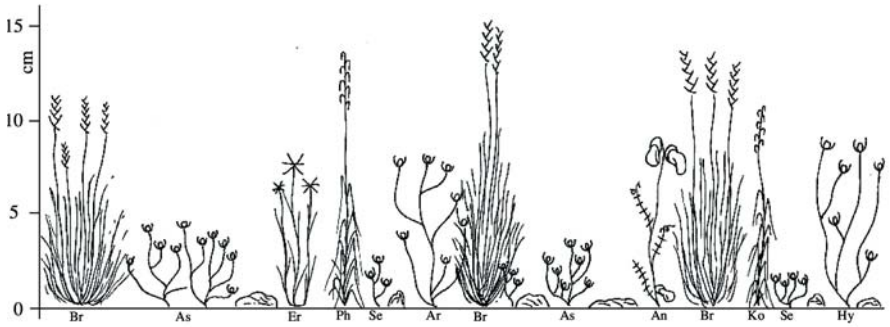
In fact, in *Brizo mediae-Brometum erecti* and in *Brizo mediae-Brometum erecti danthonietosum alpinae* all the stratification levels are extremely polyphytic while in *Asperulo purpureae-Brometum erecti* the chamaephytic and rosulaceous species tend to group in small monospecific populations. The lowest level of structural organization is reached with the Aggr. of *Sesleria tenuifolia* and *Stipa dasyvaginata* ssp. *appenninicola*, where on the one hand *Sesleria tenuifolia* forms large tufts that exclude the other species, and on the other, the chamaephytes group forms mono-specific populations that alternate in places with outcropping rock entirely devoid of vegetation.

The dimensions of the individual species also show considerable variation between *sintaxa*; *Bromus erectus*, for example, reaches the maximum dimensions in *Brizo mediae-Brometum erecti trifolietosum montanae* (with culm height between 34 and 40 cm) and the minimum value of the aggr. of *Sesleria tenuifolia* and *Stipa dasyvaginata* ssp. *appenninicola* (with culm height below 10 cm).

Transect 1: *Brizo mediae-Brometum erecti danthonietosum alpinae* – **Br** (*Bromus erectus*), **Tr** (*Trifolium montanum*), **Co** (*Colchicum* sp.), **Sa** (*Salvia pratensis*), **Ga** (*Galium verum*), **St** (*Stachys officinalis*), **D** (*Danthonia alpina*), **Fe** (*Festuca laevigata*), **Sg** (*Sanguisorba minor*), **Kn** (*Knautia purpurea*), **Ag** (*Agrostis capillaris*), **Pl** (*Plantago lanceolata*), **An** (*Anthyllis vulneraria*), **Cy** (*Cynosurus cristatus*), **F** (*Filipendula vulgaris*), **Ko** (*Koeleria lobata*), **Cr** (*Cruciata glabra*), **Bu** (*Bupleurum baldense*), **T** (*Teucrium chamaedrys*), **On** (*Onobrychis viciifolia*)



Transect 2: Aggr. *Sesleria tenuifolia* and *Stipa dasyvaginata* ssp. *apenninicola* – **Br** (*Bromus erectus*), **Ss** (*Sesleria tenuifolia*), **Sp** (*Stipa dasyvaginata* ssp. *apenninicola*), **He** (*Helianthemum oelandicum* ssp. *incanum*), **Se** (*Sedum rupestre*), **Cr** (*Carex humilis*)



Transect 3: *Asperulo purpureae-Brometum erecti* – **As** (*Asperula purpurea*), **Br** (*Bromus erectus*), **Ar** (*Artemisia alba*), **Er** (*Eryngium amethystinum*), **Ph** (*Phleum ambiguum*), **An** (*Anthyllis* sp.), **Se** (*Sedum* sp.), **Ln** (*Linum* sp.), **Ko** (*Koeleria splendens*), **Hy** (*Helichrysum italicum*)

Fig. 3: Graphic representation of the vertical and horizontal plant distribution.
The y axis represents the height in cm of the grassy cover, while the x axis represents the transect (1m) with the position of the individuals of the various species surveyed.

Phytomass

The phytomass of an association represents one of the principal components of agro-ecosystem productivity [32]: in addition to constituting a characterizing and typical element of each *syntaxa*, it has a notable importance for zootechnical purposes because it constitutes a good index for the evaluation of the ecosystem's carring capacity.

For the phytomass study, five 2x2m fenced plots were established, each divided into four areas of one square meter, in which the phytomass was mowed periodically at about two centimeters from the soil. The material gathered was divided into live phytomass and necromass, then both kinds were dried in an oven (105°Cx48h), thus obtaining the respective dry weights of the substances.

The mowings were done beginning in the first ten days of May until the first ten days of October, at intervals of 21-24 days, until the end of July, and of 30-35 days between August and October. After the first shift, in addition to mowing the virgin area, the area cut the preceding time was also re-mown in order to be able to evaluate phytomass re-growth.

The chart of resultes (Fig. 4), show how the fresh phytomass increases up to the end of June, and then decreases rapidly, except for *Asperulo purpureae-Brometum erecti* and the Aggr. of *Sesleria tenuifolia* and *Stipa dasyvaginata* ssp. *apenninicola*, which reach the maximum fresh phytomass level about 25 days early (probably because both *syntaxa* develop on southern slopes). *Brizo mediae-Brometum erecti danthonietosum alpinae* also anticipates maximum productivity by about 25 days, but in this case the reason is not clear.

The dry substance weight, translated into a percentage compared to the fresh phytomass, shows a fairly similar rate among the various *sintaxa*; in fact, the minimum occurs in correspondence with the maximum growth (with values between 30-35%), then, the percentage of dry substance increases until the end of July (reaching values between 40-50%), and then remains more or less constant for the entire summer.

In terms of necromass, *Brizo mediae-Brometum erecti trifolietosum montani* and *Asperulo purpureae-Brometum erecti* had high values already in the beginning of May (probably because these associations were neither mown or grazed the year before); in all the *sintaxa* the necromass weight tends then to increase as the summer proceeds, beginning in the end of June.

The re-growth charts demonstrate strong vegetative activity only between mowings at the beginning and end of June and more contained activity between those of September and October; it should be noted that for *Asperulo purpureae-Brometum erecti* and, to a lesser degree, for the Aggr. of *Sesleria apennina* and *Stipa dasyvaginata* subsp. *Apenninicola*, the re-growth recorded in July and then in September is due almost exclusively to the presence of chamaephytes that budded from woody shoots. It is also interesting to note the good growth of *Brizo mediae-Brometum erecti trifolietosum montani* even in the month of July, probably connected with the presence of deeper soil among those observed in the study area; another factor for its growth could be the slope's northern exposure.

In quantitative terms, for each *sintaxa* the phytomass quantity produced by each surface unit was estimated in the period of maximum vegetative growth, obtaining the following data:
Brizo mediae-Brometum erecti trifolietosum montani 89.3 q/ha of which about 35% is water content, *Brizo mediae-brometum erecti* 72.6 q/ha of which about 36% is water content, *Brizo mediae-Brometum erecti danthonietosum alpinae* 72.2 q/ha of which about 31% is water content, Aggr. of *Sesleria apennina* and *Stipa dasyvaginata* subsp. *Apenninicola* 25.4 q/ha of which about 42% is water content, *Asperulo purpureae-Brometum erecti* 21.3 q/ha of which about 40% is water content.

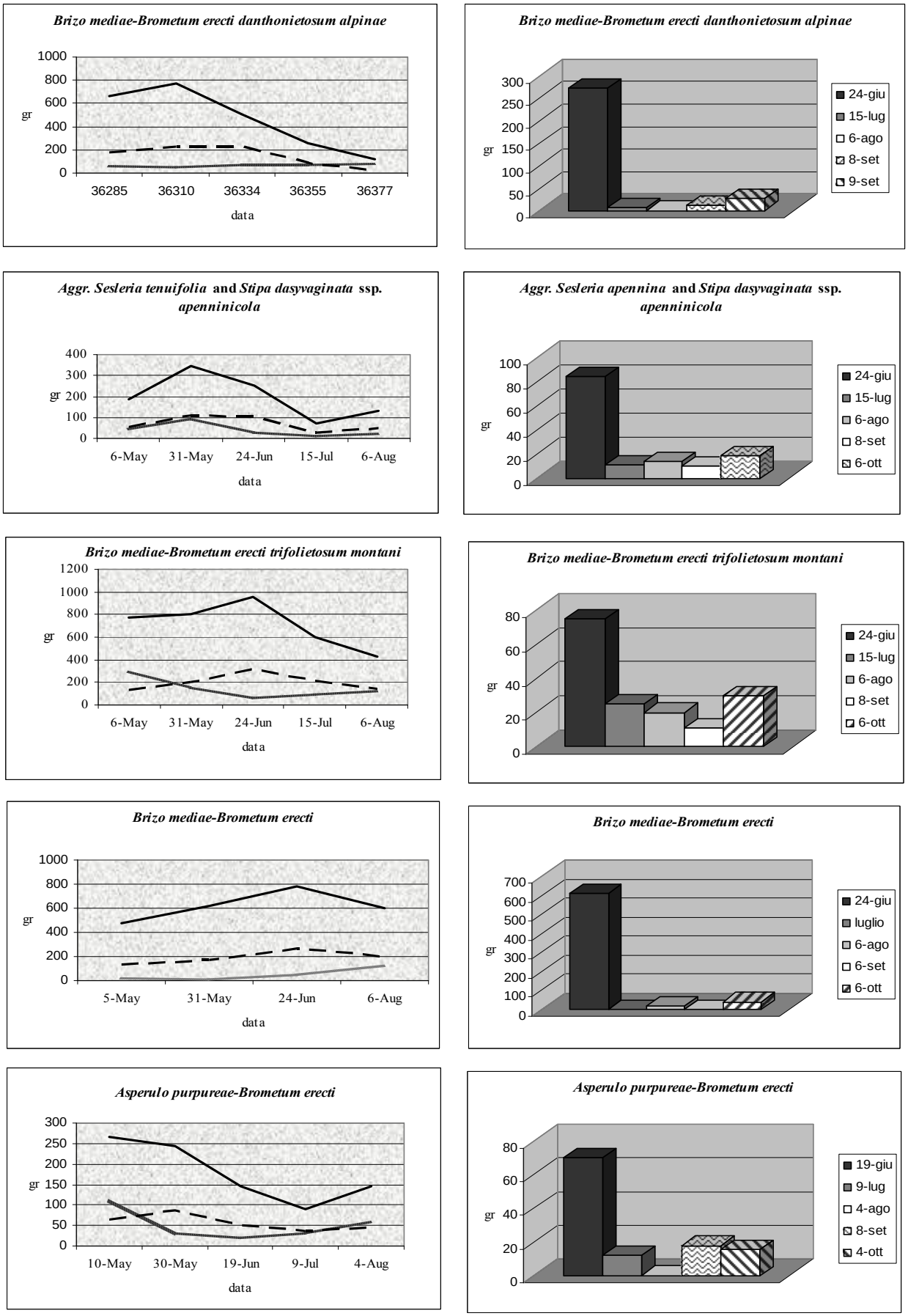


Fig. 4: The left pictures shows the rates of the fresh phytomass (----), necromass (-_-_-_) and dry substance (-- --); the right pictures shows re-growth

Morphofunctional aspects of the alimentary canal in domestic herbivores

The animal alimentary canal can be divided into three functional compartments:

a) the ingestive compartment, which handles food intake, mastication and deglutition;

b) the digestive compartment, responsible for the hydrolysis of nutritive principles in simple compounds that can be absorbed; the hydrolytic enzymes can be of endogenous nature, or produced by host microorganisms;

c) the expulsive compartment, which processes water absorption and the expulsion of undigested residue as stool [1].

Domestic herbivores can be distinguished between polygastrics or ruminants and monogastrics on the basis of the presence of a glandular stomach preceded or not by prestomach compartments, namely rumen, reticulum and omasum. Classical examples of polygastric animals are cattle and sheep; horses are examples of monogastric ones.

Domestic herbivores show many differences in the morphology and functions of the ingestive compartment of the alimentary canal (Fig. 5). In the bovine, the lips are scarcely movable and do not participate in food intake. The animal's rough and prehensile tongue encircles the fodder and pulls it to the lower teeth and the upper dental pad. The forage is then cut with a head stroke at an average height of 4 cm from the earth. Sheep instead have a movable upper lip that works with the tongue in food intake; in addition, sheep select their food more than bovines. The fodder is cut at a height ranging from 2 to 4 cm [23].

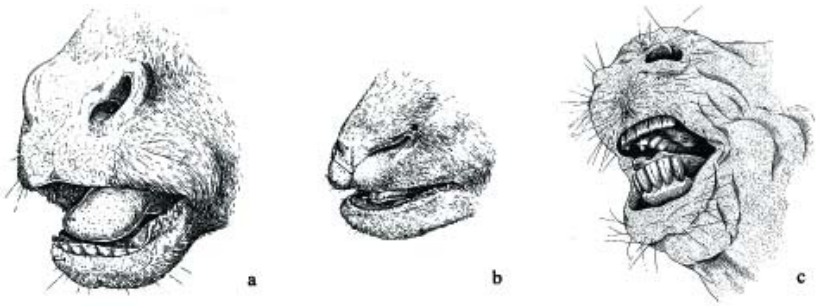


Fig. 5: Morphology of the alimentary canal ingestive compartmnet of bovine (a), ovine (b) and equine (c)

Horse's lips are extremely movable and sensitive, and also act in selecting food. During grazing, the horse's lips are retracted and the incisors cut the forage at the earth level.

Herbivores have voluminous cuspate molars which act as a grindstone for the food.

A conspicuous secretion of saliva is always associated with mastication; saliva not only mixes the food and lubricates the bolus, but also dissolves many substances into vegetable cells. The main salivary glands are the parotid, mandibular and sublingual glands; generally, horses have larger salivary glands than ruminants.

In polygastric animals, the rumen represents a great proximal fermentation room in which many bacteria and protozoa digest cellulose, forming volatile fatty acids that are absorbed by ruminal papillae.

The papillae increase the absorbing surface of the rumen. In any ruminant foetus, the papillae are thread-shaped, but once the animal is born and grazes, they change to a leaf or tongue shape when food is abundant and good; if food quality or quantity decreases, the papillae change back to a thread shape. This fact is often associated with volumetric modifications of the rumen.

In monogastric animals cellulose digestion is carried out in a distal fermentation room formed by the caecum and colon, which are less developed in polygastric animals.

On the basis of anatomical characteristics and alimentary habits, we can describe three alimentary types of herbivores (Fig. 6): a) concentrated selectors; b) intermediate types; c) grass and raw fodder eaters [25, 26].

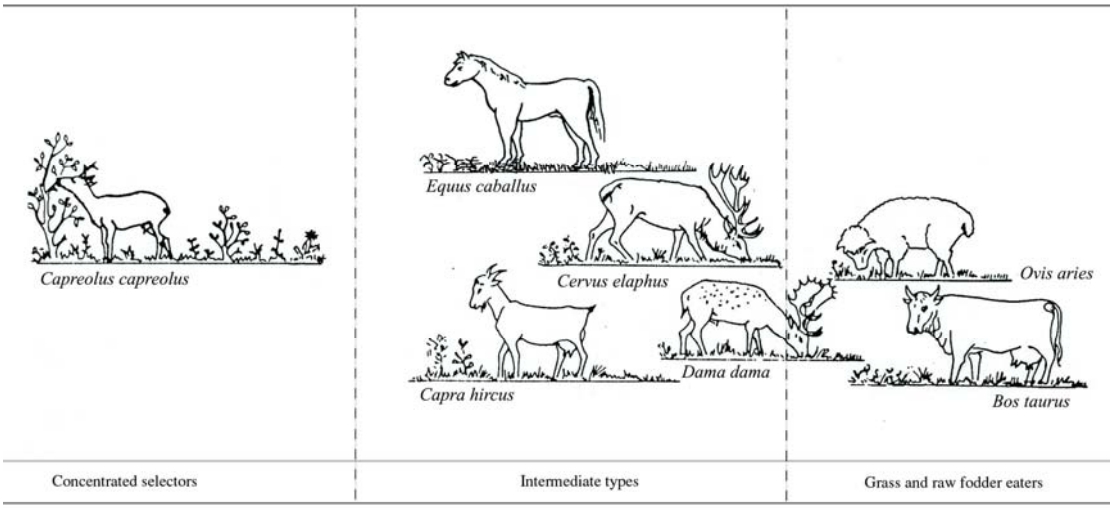


Fig. 6: Alimentary types of erbivores (modified from Hoffmann, 1984)

Some authors have noted the relationship among mouth anatomy, sward structure, grazing time, bite size and bite rate [28].

In particular, for sheep it has been demonstrated that grazing time and prehension rates decrease with the increasing height of meadows, while mastication and rumination rates increase [31]. A high-quality pasture has an optimum height between 30 and 60 mm which maximizes lamb growth rate and minimizes change in ewe live weight [31].

In addition, sheep, which have a relatively narrow muzzle, are capable of selecting plants and/or plant parts with great precision. The plant's 'mechanical resistance' to harvesting is an important factor in food selection [27]; thus, animals are more willing to eat clover and other *Leguminosae* species because they are far easier to prehend, bite and chew than *Graminaceae* ones.

Pastoral value

In order to obtain preliminary indications about the pastoral value of the various *sintaxa*, analyses were conducted based on the integration of phytosociological methodology with nutritional parameters (Is – Specific index) of the various plant species [3, 10, 13, 33]. In particular, the method utilized was that proposed by Daget and Poissonet [18], based on applying the formula:

$$Vp = 0,2x\sum CRSxIs$$

(Vp = Grazing value; CRS = Coefficient of Specific Recovering; Is = Specific Index).

CRS [36] was calculated with the following formula: $CRS = (\sum Value\ abb.\text{-}dom./N)$ (N = total number of surveys for every association; value of abundance-dominance calculated according to the system r = 0,1; += 2,5; 1= 7,5; 2= 17,5 ; 3 = 37,5; 4 = 62,5; 5 = 87,5, in which the first value is the cover index according to the traditional phytosociological scale).

For each association the Vp total was calculated given by the sum of the Vp's of all the species present in the reference phytosociological table, the Vp of the grazing *facies* [12], expressed by the species (5) that reach an overall CRS between 30 and 50.

Finally, the average annual potential carring capacity according to the formula: ***0.02xVp*** (UBA/ha year), that constitutes an index of average annual potential carring capacity of herbivores [18] in conditions of equilibrium with a constant grazing pressure and where the UBA corresponds to a 600 kg milk cow that produces produce 3000 kg of milk a year and consumes 3000 UF (Forage Units).

The results of this calculation are the following:

Brizo mediae-Brometum erecti danthonietosum alpinae: total Vp of the *sintaxa* = 101,12; Vp of the grazing *facies* = 38,72; potential carring capacity = 2,02 (UBA/ha year).

Brizo mediae-Brometum erecti: total Vp of the *sintaxa* = 76,16; Vp of the grazing *facies* = 41,74; potential carring capacity = 1,52 (UBA/ha year).

Brizo mediae-Brometum erecti trifolietosum montani: total Vp totale of the *sintaxa* = 53,93; Vp of the grazing *facies* = 32,49; potential carring capacity = 1,07 (UBA/ha year).

Asperulo purpureae-Brometum erecti: total Vp of the *sintaxa* = 48,00; Vp of the grazing *facies* = 23,74; potential carring capacity = 0,96 (UBA/ha year).

Aggr. of *Sesleria tenuifolia* and *Stipa dasyvaginata* total Vp totale of the *sintaxa* = 37,43; Vp of the grazing *facies* = 20,61; potential carring capacity = 0,74 (UBA/ha year).

It is interesting to compare this numeric datum based on the Vp with the quantitative result of dry phytomass production (dry substance – s.s.) previously reported.

Considering that 1 kg of dry substance of grazing grass has a nutritional value of approximately 0.69 UF [7] and given the dry substance production in the five experimental fenced plots, and also given a five month average stay of domestic animals (that require a nutritional portion equivalent to 1250 UF), the result in terms of the ecosystem's productivity is the following:

Brizo mediae-Brometum erecti danthonietosum alpinae: kg s.s./ha 2260 equivalent to 1559 UF and to 1,24 UBA/ha.

Brizo mediae-Brometum erecti: kg s.s./ha 2270 equivalent to 1566 UF and to 1,25 UBA.

Brizo mediae-Brometum erecti trifolietosum montani: kg s.s./ha 3170 equivalent to 2187 UF and to 1,74 UBA/ha.

Asperulo purpureae-Brometum erecti: kg s.s./ha 640 equivalent to 441 UF and to 0,35 UBA/ha.

Aggr. of *Sesleria tenuifolia* and *Stipa dasyvaginata* kg s.s./ha 1070 equivalent to 738 UF and to 0,59 UBA/ha.

As can be seen in the information reported above, there is a certain discrepancy between the data produced using the two methodologies; in particular, the evaluation on the basis of the s.s. presents values 30-50% lower than those resulting from calculation of the Vp. However, the s.s. productivity was calculated in a meteorologically unrepresentative year because of extreme aridity. Another factor to consider is the re-growth of the summer months. These two factors should lead to an increase in the UBA datum explained above.

Conclusions

The multidisciplinary method utilized has been shown capable of providing the indispensable basic knowledge for ecological and productive characterization of the grazing ecosystem.

However, to statistically validate the data it will be necessary to monitor for at least two years the rate of the phytomass, the necromass and the re-growth (correlating these data with seasonal temperatures and precipitation as well).

It will also be important to calculate for each association the relationships among *Leguminosae*, *Graminaceae* and other species and for each of these groups to evaluate their nutritional value in terms of biochemicals.

From interpolation of these results, it will be possible to obtain useful indications for establishing guidelines for evaluating the carring capacity and for managing the grazing lands. It would be very important, as well, to evaluate the grazing behavior of the flocks/herds in the floristic/vegetational context of the Apennine grazing lands.

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PĂŞUNATUL ÎN AGRO-ECOSISTEMUL MUNŢILOR ROGEDANO-PURO (REGIUNEA MARCHES, ITALIA CENTRALĂ): REZULTATE PRELIMINARE ALE UNUI STUDIU MULTIDISCIPLINAR

(Rezumat)

Lucrarea oferă primele rezultate ale unui studiu despre păşunatul agro-ecosistemelor în Munţii Rogedano-Puro, regiunea Marches din Italia Centrală, utilizând ca punct de plecare date fitosociologice, asociate apoi cu analizarea de tip pastoral. În particular este descris istoricul zonei, caracteristicile geomorfologice şi se face o caracterizare iniţială a solurilor tipice acestui teritoriu. Sunt prezentate atât date despre compoziţia floristică (Tab. 2), structura verticală şi orizontală (Fig. 3), cât şi în ceea ce priveşte productivitatea exprimată în fitomasă (Fig. 4) şi valoarea nutriţională a vegetaţiei păşunate, încadrată în 3 serii de vegetaţie şi 5 tipuri de fitocenoze praticole. În final, sunt analizate caracteristicile morfo-funcţionale ale sistemului digestiv la bovine, ovine şi cabaline pentru a oferi o analiză multidisciplinară a structurii şi valorii pastorale a pajiştilor studiate.

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