
Introduction

How to Approach This Book

Visitors who come to the Dolomites are generally tourists, during both the summer and the winter. The landscape of the Dolomites presents itself as an ensemble of cliffs and crags that loom up above the expanse of dense forests and high-elevation green grasslands. Rock and vegetation alternate in a picture of wild beauty, yet with a relationship of natural harmony (Fig. 1). Ample literature exists on the characteristics of the rocky environment of the Dolomites, from the countless guides for hikes and climbs to the scientific works of Leonardi and Bosellini. Its history began in distant geological eras, and through this, it is possible to reconstruct the characteristics of these mountains that are very particular and, indeed, unique in all the world. Forests and grasslands make up the habitat in which humans also live; nevertheless, the composition of this vegetation does not turn out to be so evident, and a general work on the plant life of the Dolomites has been lacking up to now. The topic of this book is the plant cover of the Dolomites, and its goal is to make the reader capable of understanding how it is composed, how it was formed, and what its future evolution may be. By following the discussion, the reader will be able to realize why it is that in the Dolomites, the vegetation also has characteristics that are very particular.

The study of the plant cover generally begins with a flora (Fig. 2). This name indicates books which contain the description of the plants of a certain territory and which are used in order to recognize the individual species. That is not the case with this book. As you will see below, around 2,300 species live in the Dolomites, more than a fifth of the flora of all of Europe, and thus a detailed discussion would require another volume, or else it would be conceivable to provide it with a multimedia product. Furthermore, it bears mentioning that the identification of individual species, while fascinating work, does not lead us very far ahead in the knowledge of the vegetation within its complex. Indeed, by examining the individual species, the vegetation is broken up into its fundamental components, and the view of the whole is lost. We can compare this situation to the reading of a poetic text: by critically examining the individual words, the meaning of the poem is lost; thus, the vegetation is a complex system, while the flora can be considered the linguistic tool that allows



Fig. 1 The summit of the Marmolada, the highest peak in the Dolomites, with the glacier on the north side and the gigantic south face. The vegetation has colonized the alpine grasslands and the screes (in the foreground), while in the lower area, the *Pinus mugo* formation extends (the *baranci*)

us to analyze it. The knowledge of the linguistic tool by itself does not mean also knowing the system: the knowledge of the flora is only the prerequisite, and an indispensable one, for interpreting the vegetation.

The flora is composed of the sum of the species that live in a certain territory. The species are distinguished on the basis of their qualities, and therefore the flora can be considered a qualitative concept. The vegetation, on the other hand, requires knowing not only *which* species are present, but also *how many* plants or individuals of each species. Thus in the concept of vegetation, two components are added together: the qualitative and the quantitative. These are concepts that require a certain degree of abstraction and that are taught only in university courses with a specialized character, but they are essential for the comprehension of the subject discussed here. Thus it appears to be advisable to develop them further in the section below in an historical view (for additional in-depth analysis, see the Introduction to the supplementary volume “Atlas of Flora”).



Fig. 2 After a tiring ascent, the subalpine belt is reached (the Vette di Feltre), and in spite of the rising fog, a brief stop allows for the first clarifications of the flora and the vegetation

From Flora to Vegetation

In the development of the botanical study of an area, the passage from flora to vegetation occurred progressively, during a period embracing several centuries. The first works had the character of herbal codices (such as that of P. A. Michiel from the fifteenth century, which also included several species originating from the Dolomites) or else they were codices illustrated by hand, and this style also continued in books produced after the spread of printing, such as the volume by Mattioli (sixteenth century). The necessity to provide a description of the plant, in general with the texts in Latin and with illustrations, is derived from the scarcity of reference works, which compelled every scholar to start out almost from zero. Subsequent to this (as we arrived in the eighteenth century), there began to be rather popular manuals, and in order to identify a species, the citation of the name used in those works was sufficient. This was what was done, for example, with Zannichelli in his study of the flora of the Vette, which can be considered the first botanical study concerning the Dolomites. With the publication of the work by Linnaeus (1752), binomial nomenclature was introduced which is still valid, and from that moment on, a standard existed which would be used by all subsequent authors.

It is necessary to arrive at the nineteenth century for works in which in addition to the morphological description of the individual species, information is also provided regarding their geographical distribution and their habitat. At the beginning of that century, A. P. De Candolle was the founder of botanical geography, and he attempted to define in quantitative terms the relationships between the plant species and the geographical habitat. In 1836, F. Unger published a very innovative book on the relationships between plants and substrate in the habitat of the Alps. In 1863, Kerner von Marilaun published *Das Pflanzenleben der Donauländer*, the first example of a synthesis of the environmental and biogeographical characteristics of a broad zone of

Europe. These new ideas also arrived to the botanists who were studying the Eastern Alps. In particular, F. Facchini, in his flora of South Tyrol, published in Latin in 1855, often provided notes regarding the ecology of the most significant species which are of a surprising precision, such as:

Saxifraga fassana (= *S. depressa*) - ... *sito umbroso, semper frigido, septemtrioni obverso, solo granitico*

Campanula morettiana – *Crescit ad rupes calcareas imbrium impatiens, sed laeta viget sub rupem stillicidio.*

Alyssum ovirense - ... *in glareis Vettarum*

Pinus mugus – *Crescit in petrosis, saxosis, asperis, arenosis siccis, etiam in uliginosis, palustribus sphagnosis, montis omnes calcareos mediocris altitudine, abietis terminus tractu mediocri superans, inde montium in latera vestens, ad Vitis regionem usque imprimis locis umbrosis vel septemtrioni obversis.*

It is very interesting that sometimes, the text includes a description of not only a particular species, but also other species growing together along with it. For example, for *Cherleria octandra* (= *Minuartia cherlerioides*), Facchini observes that it is associated [*sic!*] with *Saxifraga squarrosa*, which is exactly what can be seen in the tables of rupestrian vegetation on limestone (see Chap. 13).

Up to this point, the main goal of those studying the flora has been to arrive at recognizing the species that compose it, distinguish them from each other, and provide them with a scientific name: a need that was essentially one of classification. For that matter, that is also the principal objective for those who today are making their first approach in the study of Alpine flora. Nevertheless, the aim of this work is the vegetation and not the flora. Therefore, for the identification of the species, it is worthwhile to utilize one of the many floras of the Alps or else the *Flora d'Italia* (Pignatti 1982), while the study of the vegetation constitutes the passage to a more complex stage of knowledge. This is already outlined in the notes of Facchini reported above, but with regard to the evolution of the plants and the communities, the acquisition of new concepts is required. From the classification of the phenomena, we move on to the explanation of the causes behind them.

Only in the twentieth century (and especially in the latter half of it) did the tendency develop to overcome the simple descriptive discussion of the species and to integrate it with the study of the events that led to their differentiation within the framework of the theory of evolution. In the early decades of the past century, the knowledge accumulated, and in a publication by Gams dated 1931–1932 (in which the index of hygric continentality was proposed), we already read, as quoted in Scharfetter 1938, that, “The presentation of the recent results could fill a work of several volumes, but the time for this is not yet ripe, because many problems still remain to be clarified, and the study in the various areas has reached very different levels.” During this period, two thematic areas came to progressively be differentiated, based upon an alternative approach: the study of external factors and the study of evolutionary mechanisms (primarily internal ones) of living things, a distinction which in any case remains formal because, often, these two points of view are integrated and overlap each other.

The study of external factors regards above all the geographical distribution of species that are particularly important. One of the pioneer botanists of this area was R. Pampanini (Fig. 3), a native of Cadore, who in 1902 defended his graduation thesis at the University of Lausanne (published in 1903) with this subject. In the subsequent decades, considerable knowledge was accumulated, up to the first atlas of Meusel,



Fig. 3 R. Pampanini (1875–1949)

published in the years during the Second World War. A first synthesis of the knowledge of the external conditions that determine the life of plants in the Eastern Alps was already proposed in Scharfetter (1938): a book that makes possible a broad synthesis of the phytogeographical problems, based upon an imposing analysis of the literature. But this volume had scant circulation, not least because of the wartime events, and it remained nearly without a following. The topic was subsequently picked up again on the basis of the greater knowledge available, thanks above all else to the progress made in the fields of geology and geomorphology: continental drift and, with regard to the Alps, the reconstruction of the repeated glaciations during the Quaternary Period. By connecting this evidence with the distributional areas of the Alpine plants, H. Merxmüller (Fig. 4) arrived (1952–1954) at the clear formulation of the “north–south disjunction model” for the species that were able to survive during the glaciations remaining confined in the refuge locations along the southern and northern margins of the Alps. This is an essential model which will be broadly taken up again in our discussion.

The study of the microevolutionary mechanisms initially developed by means of the definition of the chromosomal arrangement of the populations and of polyploid series. Pitschmann and Reisigl (1957) studied the endemic species of the Southeastern Alps, while Ehrendorfer, with the research on *Galium*, *Achillea*, and other critical groups, and Favarger—with extensive cytotaxonomic examinations—brought to light some evolutionary models of general value. Along the same lines, the most recent studies by Küpfer regard the relationships between the flora of the Alps and



Fig. 4 H. Merxmüller (1920–1988), photo courtesy of Prof. M. Erben

that of the Pyrenees, as well as that of Iberia in general. The study at the chromosomal level (cytotaxonomy) was developed in the last two decades in chemotaxonomic research and molecular analysis and provides direct information on the phylogeny of plants: research in these fields is still undergoing rapid development. In this way, the modern approach no longer considers the flora as the sum of the species, but rather the relationships between the species as the result of processes of speciation of basic value. With this, we pass from the specific—that is, the study of individual species—to a general view.

At the same time, however, the direct approach to the study of vegetation is also developing: phytosociology. This is a new manner of considering the plant world, based upon the fact that when plants grow in their natural habitat, they are not distributed at random: the daisy grows in the meadows, the strawberry at the edge of the forest, and the gentian in alpine grasslands. Thus the plants associate with each other forming communities, which are then present without important variations wherever they have the particular environmental conditions. The communities constitute the vegetation, which is studied by means of phytosociology. This was already seen by Facchini (“*Cherleria Saxifragae socia. . .*”), but it was proposed as an axiom when Josias Braun-Blanquet (Chur 1884–Montpellier 1980, Fig. 5) proposed the integration of knowledge at a higher level: the vegetation. In this way, we move

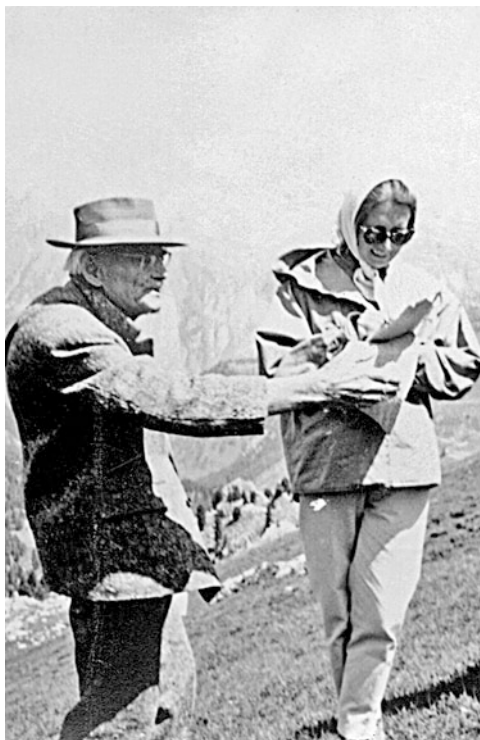


Fig. 5 Josias Braun-Blanquet (1884–1980) with Erika Pignatti taking a relevé at the Sella Pass in summer 1961 (photo by F. Pedrotti)

from the flora (the sum of the species) to the plant association*, in which the species are interpreted as components of a community. The association is the foundation (the *Grundbaustein*, according to Braun-Blanquet) upon which the interpretation of the plant habitat rests. The phytosociological approach was initially developed on the vegetation of the high mountains in Switzerland and on the Mediterranean vegetation around Montpellier, and it was applied by students of Braun-Blanquet to other parts of Europe. Among them, E. Aichinger (Fig. 6) brought along his forestry experience, which induced him to conceive the plant association as a reality in continuous transformation according to rules of general significance. With the publication of the monograph on the Karawanken (Aichinger 1933), the knowledge of the vegetation of the Eastern Alps by means of the phytosociological method was set into motion.

Let us summarize the levels of investigation developed in the study of the plant life of the Dolomites:

- **flora** the totality of the plant species that grow in a particular site
- **vegetation** a totality of plants belonging to different species that grow in their natural arrangement; it is interpreted on the basis of the concept of *association* (plant community); see the Glossary* at the end of the book
- **landscape** a totality of associations connected with each other in a *vegetation complex*, see the Glossary* at the end of the book



Fig. 6 E. Aichinger (1894–1985)

Phytosociology

A community that is very widespread in the Dolomites and well known to all those who have been in these mountains is the coniferous forest (of *Picea abies*, commonly known as Norway spruce). Examining it in greater detail: it has a characteristic structure, with the *P. abies* forming the tree layer, below which there is a layer of low shrubs, generally species of *Vaccinium*, and at ground level, a carpet of mosses. Famous examples of *P. abies* forests are the Karer Forest, the Paneveggio Forest, the Weissenstein Forest, and several others. In the various examples, we can find small differences with regard to the flora: there are in fact species that grow at Paneveggio but are lacking at Weissenstein, and vice versa. Nevertheless, as emerges from photographs of the whole, the general structures remain substantially the same. In this way, the *P. abies* forest can be defined as a plant association, which is repeated, with random variations of little importance, every time that the particular environmental conditions are present. The connection between the association and its habitat is a general fact: relationships are established between the two that constitute the subject of the study of phytosociology.

The relevés* were carried out every time that during the course of excursions, a vegetation was observed which appeared to reflect a particular condition of environmental equilibrium, and thus without any subjective selection of the area to investigate. That explains the particularly extended time of our field research (more than

40 years!), as well as a certain imbalance between some subjects that have been studied particularly in depth (such as the grasslands on limestone) and others that received a summary discussion (especially the vegetation of wet habitats). In this way, though, there has been the advantage of providing an objective image of the surrounding reality while avoiding the peril of working only by means of the application of preconceived ideas.

The total number of relevés carried out in the Dolomites that are presented here amounts to 2,041. This represents a profusion of data without parallel in other research published in Italy, and in other European countries, the examples of works that are based upon information that is likewise as vast are also quite rare. Only a small number of these relevés have been used for some preliminary notes that were previously published; the large majority of them are therefore unpublished and are made available to the scientific community for the first time here.

The Ecology of the Landscape

The study of the landscape units (for greater detail, see Chap. 19) was carried out by means of the surveying of the vegetation complexes (437 surveys carried out on various occasions and more or less throughout the entire territory of the Dolomites). One particular experience is represented by the route of the Dolomite Trail No. 2 (Brixen-Feltre) traveled entirely on foot in 1979, which made it possible to study a north–south transect along the entire complex of the Dolomites. For the theoretical basis of the approach that was used and for the methods of surveying and the processing of the results, see Pignatti (1994). The complex of information regarding the plant landscape of the Dolomites certainly represents one of the examples of greater complexity that have been examined thus far in the specific literature. The relevés were processed by means of a single matrix with methods of multivariate analysis, which has made it possible to distinguish around 30 vegetation complexes. In Chap. 19, the data are presented in synoptic form, while for a detailed representation refer to the tables in the supplementary volume “Atlas of Flora.”

Methodological Organization

At the base of this study is the concept of the perception of the environment at three levels (Fig. 7). The same subject, if observed at the microscale, can result in individuals, populations, and species (flora); at the mesoscale, the communities (vegetation) are revealed to us; and at the macroscale, there are the vegetation complexes and the landscape (Pignatti 1994). The result of the analysis at the microlevel is the flora, that is, the totality of the species that are spontaneously present throughout the territory of the Dolomites. This has been realized by means of the floristic census which, due to its size, will be published in the form of the supplementary volume “Atlas of Flora.” The analysis at the mesolevel has been realized by means of the phytosociological study, that is, the individuation of the vegetation, composed of the various plant communities. It represents the central topic of this work, which is then followed by the collection of phytosociological data (tables, locations, georeferentiation) in the supplementary volume “Vegetation Tables.” The macrolevel makes it possible to analyze the components of the

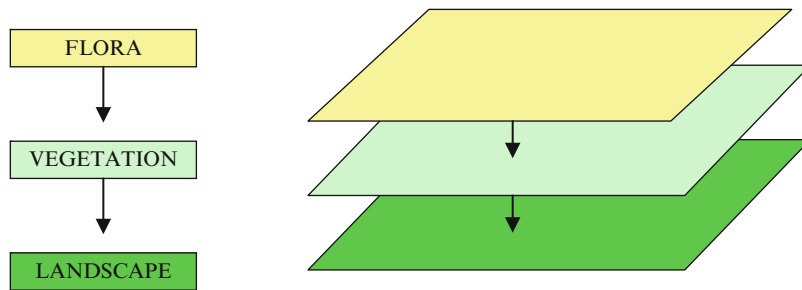


Fig. 7 The environment is interpreted according to three levels of perception: flora, vegetation, and landscape

landscape of the Dolomites by means of the definition of landscape units (Chap. 19). The three levels have different characteristics and a progressively increasing degree of complexity. The articulation into three levels makes it possible to comprehend the relationships between them (Deil 1997) and the role that humans have played in molding this reality.

The Authors' Research in the Dolomites

We began botanical research in the Dolomites on August 1, 1960, along with our friend Ruben Sutter from Scuolms near Chur, Switzerland. One of us (E.P., née E.W.) already had prior experience regarding the vegetation of the Lienz Dolomites (dating back to 1949), and the other (S.P.) had spent long periods in the Dolomites as a child at Cavalese, Pera di Fassa, and Lorenzago and knew many routes in the high mountains, and he later did his first studies on Alpine flora in the Lombardian Alps (Stelvio and Spluga). At the time, there were no botanists active in this area who could act as our guides. After the first excursion in 1960, only brief visits were carried out until extensive research during the summers of 1968 and 1969 in the Sauris basin at the eastern extreme of the area of the Dolomites. Starting in 1970, long periods were spent in the Dolomites every summer in order to realize a detailed botanical investigation and to study the vegetation of those mountains using the phytosociological method. In the beginning, this investigation occurred without a precise plan, following more or less well-known tourist routes. Only in the 1980s did systematic surveying begin in such a way as to visit every valley and the individual mountainous massifs. For the details of this research, see the introduction to the supplementary volume "Atlas of Flora." At the end of the 1980s, the survey of the plant communities could be considered practically complete, and the experience on vegetation complexes was developed with the first map of landscape units (the *Foglio Cortina* of 1981).

The first ecophysiological measurements on Alpine vegetation were carried out with the traditional instruments (a mercury thermometer, a hair hygrometer, and a photometer with the scale in lux) obtaining only orientational data. Starting from 1987, though, it was possible for us to have at our disposal a new generation of portable instruments which made it possible for us to carry out measurements in the field with the precision necessary for scientific research. In subsequent years, the dedication was above all to the floristic inventory and to the rough surveying of

the plant cover, realizing a cartography at a 1:25,000 scale which thus far has remained unpublished (some of those pages served as the basis for the realization of the prototype of the *Carta della Natura*, which was realized later by the University of Parma on behalf of the Agenzia Nazionale per la Protezione dell'Ambiente, or ANPA—the Italian National Agency for Environmental Protection). In 2000, the work began to assemble, coordinate, and process the results collected over at this point 40 years of research, as well as the writing of the explanatory texts. The phytosociological data have been collected into tables and subjected to processes of ordination and classification with methods of multivariate analysis. The database of the flora was realized, and from it, the floristic atlas was constructed (see the supplementary volume “Atlas of Flora” for details and collaborations). In 2001–2004, thanks to instruments that were further perfected, it was possible to complete the research on the microclimates and the ecophysiological behavior of the Alpine flora and vegetation. The complete manuscript for the book was delivered in June 2006, after which time only broad and general revisions have been carried out.

From this summary of the research activities, it is clear that our study of the Dolomites was developed contemporaneously with the writing of the *Flora d'Italia* by one of us (S.P.) which was published in 1982. An intense osmosis occurred between the contents of the two works. In particular, both the taxonomic concept for the polymorphic groups and the nomenclature of the *Flora d'Italia* from 1982 were used during the investigations in the field. This poses a great problem in that the taxonomic nomenclature in recent years has been profoundly modified with respect to that which was standard in 1982. At this point, it seems necessary to update the nomenclature according to the standard that has already been realized for the second edition of the *Flora d'Italia*. In actuality, there currently does not exist a published work to use as a reference: there are lists (Argenti and Lasen for the province of Belluno, Wilhalm et al. for the province of Bolzano, and the checklist of Conti et al.) which can be used as valid support. Many species that characterize vegetation units have in the meantime changed name (for example, *Loiseleuria* and *Oxycoccus* have changed to *Kalmia* and *Vaccinium*, respectively), which often makes the comprehension of the texts difficult. Despite these difficulties, we hope that the use of an improved nomenclature will be appreciated by the scientific community.

Three Itineraries for Getting to Know the Flora of the Dolomites

Let us now imagine a journey for getting to know the Dolomites, a territory to which there is nothing similar in other parts of the world, and let us do this with a particular interest in the flora, the vegetation, and the landscape. Those arriving from industrialized areas that are densely populated, from Northern Italy and Central Europe, can arrive here from any side, by train, by car or other motorized means, by air, and, if desired, even by walking or on bicycle. But in all of these cases, the entry into the world of the Dolomites remains rather similar: one reaches the mountains on foot, ascends, and encounters at different levels belts of vegetation that more or less correspond. The environment of the Dolomites is characterized by the crags. Why, then, direct our attention to the plant cover? Because this provides us with the key to reading the landscape. In fact, in the landscape we can immediately perceive both the physical reality of mountains, running water, and rocks and the human environment of roads and populated centers. Between the two, there are only

limited occasions for direct contact. Instead, the connection between humans and the inert substrate occurs through the vegetation, the irreplaceable interface. The habitats in which it is missing are indicated as deserts. In the Dolomites, on the other hand, the plant cover achieves a state of development and naturalness that can be found rarely in other areas of Europe. Our discussion helps to comprehend the landscape of the Dolomites by utilizing information that arrives to us from the vegetation.

The three itineraries start out from the three cities which are closest to the Dolomites and which historically have most often represented the starting point for journeys in this territory: Bolzano, Feltre, and Belluno. Obviously, other departure points could be chosen which are no less suitable, from Trento to Toblach. The sequence that is defined in the three itineraries is the same one that will be followed in subsequent chapters.

Itinerary I: From Bolzano to Castelfeder—Cavalese—Lavazé—Karer Pass—Karersee—Latemar and Rosengarten

The city of Bolzano is not in the actual Dolomites, but rather is found in the center of a basin composed of volcanic rocks. The Dolomites are close by, though, and they can be seen from the city. Upon arriving by train to the Bolzano station on clear days, there is already an incomparable view from the window of the Rosengarten and Vajolet Towers. When the arrival of spring announces itself with the first flowerings in the hills that surround Bolzano, these mountains are still covered with snow in all their majesty. From Bolzano, the roads branch off to the Val d'Ega and the Tiers Valley, which climb up to the Dolomites. For a more gradual approach, it is worthwhile to begin from the Adige Valley, for example at Castelfeder, around 15 km further south. From this panoramic point, the cultivated landscape dominates, with permanent meadows, vegetable gardens, vineyards, and fruit orchards (see Chap. 2) alternating with broadleaf woods and arid grasslands (see Chaps. 3–4). The road continues, crossing the San Lugano Pass and reaching Cavalese. From here, the splendid Val di Fiemme opens up, still marginal with respect to the Dolomites, but in the background, the view of the Pale di San Martino already appears. The left side of the Val d'Avisio, on the slopes of the Lagorai, is covered by a dense belt of coniferous forests. The ascent goes to Lavazé and from there to the Karersee, always continuing through the forest, interrupted by brief open spaces (Chaps. 5–7). The nearby mountains (the Schwarzhorn and Zanggenberg) are for the most part siliceous and covered by acidocline grasslands (Chap. 8). Once the Karer Pass has been reached, we enter into the heart of the Dolomites—the Roda di Vael looms above the pass and continues on two sides with the massif of the Rosengarten. Countless paths and hiking routes abound, and the more expert can also take the mountain route across the Santner Pass. The opposite side leads up the Latemar. Further away, a glimpse can be caught of the Langkofel, Sella, and Marmolada. This is where the alpine vegetation on dolomites develops (Chaps. 9–13), the main topic that brings our discussion to a close.

Itinerary II: From Feltre to the Valle di Primiero—Rolle Pass—Cima di Bocche—San Pellegrino Pass—Ombretta—Marmolada

The city of Feltre rises up on a hill that dominates the valley, and it is perhaps one of the oldest inhabited centers in the Dolomites. For millennia, it has played an important role as a center of civilization and culture for the entire region. The slopes of the hills around the city have been transformed into stable meadows and fruit orchards (Chap. 2), alternating with broadleaf forests, such as those of *Carpinus betulus* and *Fagus sylvatica* (Chap. 3), and steppe grasslands (Chap. 4). Above Feltre, the mountain chain of the Vette rises up, with its great naturalistic value, but for the moment, it is worthwhile to leave it aside, because its prealpine character can be comprehended only once there is a clear idea of the Alpine vegetation. We continue toward the Val Cismon, still among woodlands of *Carpinus betulus*, *Ostrya carpinifolia*, and *Fagus sylvatica*, and we reach the basin of the Valle di Primiero with broad grasslands and stable meadows. From here, the conifers begin to predominate in the forest vegetation (Chap. 5), and they continue as far as San Martino di Castrozza and the Rolle Pass. From this pass, the vegetation of the Dolomites is immediately accessible by ascending to the plateau of the Pale di San Martino, or else we can proceed along the eastern edge of the volcanic area of Predazzo, toward the Valles Pass and Giuribritto, and across the vegetation of the acid substrates (Chaps. 6–8) as far as the San Pellegrino Pass. We descend along the green meadows of Fuchiade and we very soon reach the habitat of the Dolomites, with a great richness of vegetational aspects (Chaps. 9–13) and different possibilities of routes on the high-elevation paths: toward the left to the Sella Pass toward the Valle di San Nicolò and the Val di Fassa, toward the right for the Forca Rossa to the Cime d’Auta, Falcade, and—by crossing the Val Cordevole—to the Civetta range. But more expert climbers continue straight after the Cirelle Pass, and from there across the Ombretta and Ombrettola, they arrive at the Marmolada, the highest peak of the Dolomites, and at the Vial del Pan, one of the gems of the Dolomites, that connects the Marmolada with the Sella range.

Itinerary III: From Belluno along the Valle del Piave to Pieve di Cadore—Cortina—Giau Pass and Falzarego Pass—the Ampezzo Dolomites

Belluno developed in an easily defensible position on a rocky, overhanging spur on the Piave and on the deep ravine of the Ardo. In the surroundings, the glacial molding is evident: the gentle slopes of the morainic hills are to a large extent occupied by stable meadows and fruit orchards (Chap. 2), but it is also possible to find oak forests there that have been well conserved (Chap. 3), which have now become a rarity in Italy. From the city, the approach to the Dolomites can be direct and immediate: all that is necessary is to ascend the Valle dell’Ardo, through forests and arid grasslands (Chaps. 3–4) and cross the Schiara to find oneself in the full environment of the Dolomites. Nevertheless, this hiking itinerary is one reserved for experts in the mountains. For an approach that is more gradual, it is better to travel along the Piave Valley (or else detouring for Zoldo and Cibiana) as far as the basin of Pieve di Cadore. The edges of the *Fagus sylvatica* forest accompany us as far as here and beyond (Auronzo). In the Cadore region, the stable meadows predominate, and only

as we penetrate the Valle del Boite do we move on to the coniferous forest (Chap. 5). The peaks of the Dolomites are now nearby: the Marmarole, the Antelao, and then the basin of Cortina is reached, completely surrounded by the crags. Only on the side of the Giau Pass, and for those who ascend from the Val Cordevole and Livinallongo, is a siliceous belt crossed with vegetation of wet locations (Chap. 6) and plant formations on an acid substrate (Chaps. 7–8). From Cortina, an unrivaled view can be enjoyed of the massifs of the Dolomites. Those wishing to continue further can arrive at Misurina, the Drei Zinnen, and the Sexten Dolomites, or else to the plateaus of Fanes and Sennes and as far as the Pragser Wildsee. The vegetation of the cliffs is described in Chaps. 9–13.

One should not think that with these three itineraries, the exploration of the Dolomites could be said to be concluded. We have only just touched upon the Sella and completely left out the Val Gardena, Val Badia, San Cassiano, the Pelmo, the Agner, and many other mountain ranges. With regard to the siliceous chains, we also must point out the Lagorai, Colbricon, and, at the other extreme, the Comelico region and the Val Vissdende. While traveling through the Dolomites, we discover new and unexpected aspects everywhere, but we also find relationships that repeat themselves with regularity: a fine example of unity within diversity.

Organization of the Book—Description of the Associations

Ecograms

An *ecological space* is represented schematically and is characterized by means of two Cartesian axes:

- on the abscissa, the climate, from a maximum of oceanicity (to the left) to the maximum of continentality
- on the ordinate, the elevation above sea level, from the valley floor (on the bottom) to the peaks (at the top)

On the x axis, the climatic gradient is indicated, from the maximum of oceanicity (left side), which corresponds to the southern edge of the Dolomites, to the maximum of continentality (right side), corresponding to the orographic left of the Puster Valley. On the y axis, the elevation is indicated in meters above mean sea level. This corresponds to a gradient of luminous radiation (which is at its maximum at the highest elevation and decreases toward the valley floor) and to a temperature gradient (which has the opposite trend). It should be borne in mind that in the background, the color yellow corresponds to the continental climate and the blue to the oceanic climate.

Analytical Charts

These have been constructed as block diagrams which are read from left to right in the direction of the arrows. Every arrow leads to a node with a box containing a concept. The subsequent arrows (two or more) indicate the different possibilities that are mutually exclusive: one of these is selected that corresponds to a successive node, and so on until the identification of the researched association. It is necessary to pay

attention to the colors, which have been selected in such a way as to provide ecological information:

- **green** associations on a calcareous or dolomitic substrate
- **red** associations on an acid substrate (lavas, granites, porphyries, etc.)
- **blue** associations in wet habitats

Two-color fill effects indicate the transition from one condition to another.

Synoptic Association Tables

In the synoptic association tables (Chaps. 2–13), the presence percentage has been calculated for all of the species. In this way, every association is reduced to a single column. It is thus possible to compare the percentage values of the species with each other and to have a comparative framework between the compositions of the individual associations. The tables are provided in detail in the supplementary volume “Vegetation Tables.”

Datasheets

In the phytosociological literature, the description of the individual communities is carried out by means of descriptive texts which do not always turn out to be comparable with each other. For the vegetation of the Dolomites, in each of the Chaps. 2–13 a group of associations is described with a general introductory text followed by a series of datasheets, one for each association. A series of subjects are treated for each association in a manner that is analogous, or else with few variations, in such a way as to provide a description that is as uniform and devoid of gaps as possible. In addition, four tables are added in all of the datasheets which list in a standardized manner for all of the associations the following (average) numerical data (parameterization):

- distribution in relation to elevation and to the continentality of the climate
- physical parameters
- biological parameters
- the necessity for conservation measures (evaluation of the risk and the heritage value)

In the table regarding conservation, scales are used with values from 1 to 5. In the final evaluation (the column on the right), 1 represents the maximum risk and heritage value and 5 the minimum. The numerical evaluation of risk is based only upon the data calculated for each association and not upon opinions of the observer.

In addition, every datasheet includes a photographic image of the association and the distributional map. In this way, an immediate comparison is possible between all of the associations that have been identified in the Dolomites.

Glossary

Terms explained in the Glossary at the end of the book are marked by an asterisk.

What is Phytosociology?

At this point, we may ask ourselves: *What is phytosociology?* The subject of the sociology of plants, or phytosociology, is the study of plant communities: plant associations*. The survey of the vegetation is accomplished in the field through the use of the phytosociological method (Braun-Blanquet 1928), that is, a statistical sampling. The essential phase of the procedure is the *relevé*, which is carried out on a surface that is sufficient to contain all of the components of the association (in general, 100 m², or more in the forests). All of the species that are present and the area covered by each one are noted. After this, once a sufficient number of relevés is available to identify a type of vegetation (generally at least 10–20 relevés), they are put together in a table and compared with similar relevés originating from other zones.

The comparison is carried out by means of statistical methods, of which numerous versions exist today that can be utilized through the use of computers. In this way, the validity of the association, its territorial distribution, and the geographic area occupied by it are all tested. Associations are identified with a similar but not equal composition and which substitute each other in different geographical areas or else where the conditions of the terrain change. In this way, every association comes to occupy its own ecological space.

The associations are indicated by means of a nomenclature derived from the scientific name (in Latin) of one or two species that most characterize it. For example, in the case of the Norway spruce forest, there is the *Listero-Piceetum*: the name includes elements of *Picea abies*, which is the dominant tree, and *Listera cordata*, a small orchid that is not very observable but which is present exclusively in this association. Other types of *P. abies* forests exist, but *L. cordata* is lacking in them, and they have names such as *Veronico-Piceetum* or *Homogyno-Piceetum*, which are characterized by *Veronica urticifolia* or *Homogyne alpina*, respectively. The associations are joined together in progressively broader units, the names of which are formed in a manner that is analogous to those of the associations but with a change in the suffix. The name of an association ends in *-etum*, while that of an alliance ends in *-ion*; an order, *-etalia*; and a class, *-etea* (hence, *Piceetum*, Piceion, Piceetalia, Piceetea).

Both of the authors of this book are direct students of Josias Braun-Blanquet, having had the possibility of carrying out a study and research stage under his guidance at the Station Internationale de Géobotanique Méditerranéenne et Alpine in Montpellier in 1952–1953 and also having subsequently participated in numerous excursions together with this scholar in many areas in both Alpine and Mediterranean habitats. As we write, we are among the very few still living who had the privilege of a prolonged relationship and friendship with the Maestro. Among the pioneers of phytosociology, Erwin Aichinger is also worthy of mention, one of Braun-Blanquet's first students who had a long period of activities in research and administration in the forests of Carinthia. We were bonded to him by a warm friendship and collaboration that lasted more than 30 years. His monograph on the vegetation of the Karawanken (1933) has in many cases served as the model for our research in the Dolomites.

The phytosociological method is based upon the observation that the distribution of plants in a habitat is not entirely subjected to chance. The falling of the seeds may be random as they are carried by the wind or by surface water, but the germination and taking root are already phenomena that are regulated by the soil factors. With the growth, there is a further selection, and the plants come to organize themselves into communities in which relationships of coexistence establish themselves between the various species, relationships that regulate the distribution in space (where the various individuals grow), in time (the rhythms of flowering), and in many other aspects of plant life. Further relationships are established with the soil and the fauna; it suffices to mention the herbivores—which, with respect to the plants, are the predators—and the pollinators, which regulate the reproduction of a great number of plants. The plant *association* is the expression of the process of self-organization that is realized in the meadow, in the forest, and in the other types of vegetation, and therefore, its composition is an expression of the environmental equilibrium.

Plant Life of the Dolomites

Vegetation Structure and Ecology

Pignatti, E.; Pignatti, S.

2014, XXXVII, 771 p. 503 illus., 16 illus. in color.,

Hardcover

ISBN: 978-3-642-31042-3