

World Heritage Sites

Protected
Areas and
World
Heritage



THE DOLOMITES ITALY

The nine components of The Dolomites World Heritage property protect a series of highly distinctive mountain landscapes that are of exceptional natural beauty. Their dramatic vertical and pale coloured peaks in a variety of distinctive sculptural forms are extraordinary in a global context. This property also contains an internationally important combination of earth science values. The quantity and concentration of highly varied limestone formations is extraordinary in a global context, whilst the superbly exposed geology provides an insight into the recovery of marine life in the Triassic period, after the greatest extinction event recorded in the history of life on Earth. The sublime, monumental and colourful landscapes of the Dolomites have also long attracted hosts of travellers and a history of scientific and artistic interpretations of its values.

COUNTRY

Italy

NAME

The Dolomites

NATURAL WORLD HERITAGE SERIAL SITE

2009: Inscribed on the World Heritage List under Natural Criteria vii and viii.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE

The UNESCO World Heritage Committee issued the following Statement of Outstanding Universal Value at the time of inscription:

Brief Synthesis

The nine components of The Dolomites World Heritage property protect a series of highly distinctive mountain landscapes that are of exceptional natural beauty. Their dramatic vertical and pale-coloured peaks in a variety of distinctive sculptural forms are extraordinary in a global context. This property also contains an internationally important combination of earth science values. The quantity and concentration of highly varied limestone formations is extraordinary in a global context, whilst the superbly exposed geology provides an insight into the recovery of marine life in the Triassic period, after the greatest extinction event recorded in the history of life on Earth. The sublime, monumental and colourful landscapes of the Dolomites have also long attracted hosts of travellers and a history of scientific and artistic interpretations of its values.

Criterion (vii): The Dolomites are widely regarded as being among the most attractive mountain landscapes in the world. Their intrinsic beauty derives from a variety of spectacular vertical forms such as pinnacles, spires and towers, with contrasting horizontal surfaces including ledges, crags and plateaux, all of which rise abruptly above extensive talus deposits and more gentle foothills. A great diversity of colours is provided by the contrasts between the bare pale-coloured rock surfaces and the forests and meadows below. The mountains rise as peaks with intervening ravines, in some places standing isolated but in others forming sweeping panoramas. Some of the rock cliffs here rise more than 1,500 m and are among the highest limestone walls found anywhere in the world. The distinctive scenery of the Dolomites has become the archetype of a "dolomitic landscape". Geologist pioneers were the first to be captured by the beauty of the mountains, and their writing and subsequent painting and photography further underline the aesthetic appeal of the property.

Criterion (viii): The Dolomites are of international significance for geomorphology, as the classic site for the development of mountains in dolomitic limestone. The area presents a wide range of landforms related to erosion, tectonism and glaciation. The quantity and concentration of extremely varied limestone formations is extraordinary in a global context, including peaks, towers, pinnacles and some of the highest vertical rock walls in the world. The geological values are also of international significance, notably the evidence of Mesozoic

carbonate platforms, or "fossilized atolls", particularly in terms of the evidence they provide of the evolution of the bio-constructors after the Permian/Triassic boundary, and the preservation of the relationships between the reefs they constructed and their surrounding basins. The Dolomites also include several internationally important type sections for the stratigraphy of the Triassic Period. The scientific values of the property are also supported by the evidence of a long history of study and recognition at the international level. Taken together, the combination of geomorphological and geological values creates a property of global significance.

Integrity

The nine component parts that make up the property include all areas that are essential for maintaining the beauty of the property and all or most of the key interrelated and interdependent earth science elements in their natural relationships. The property comprises parts of a national park, several provincial nature parks and Natura 2000 sites, and a natural monument. Buffer zones have been defined for each component part to help to protect it from threats from outside its boundaries. The natural landscapes and processes that are essential to maintaining the property's values and integrity are in a good state of conservation and largely unaffected by development.

Protection and Management requirements

As a serial property, the Dolomites require an adequately resourced, inter-provincial governance arrangement that ensures all five provinces with territory in the property are bound together within a common management system, and with an agreed joint management strategy and a monitoring and reporting framework for the property as a whole. Common policies and programmes for the management of public use and the presentation of the property are also required for the property and its buffer zones. The property requires protection from tourism pressures and related infrastructure.

Each of the component parts of the serial property requires its own individual management plan, providing not only for the protection and management of land use, but also the regulation and management of human activities to maintain its values, and in particular to preserve the qualities of its natural landscapes and processes, including extensive areas, which still have wilderness character. Areas that are subject to more intensive visitation need to be managed to ensure visitor numbers and activities are within the capacity of the property in relation to the protection of both its values and the experience of visitors to the property. Adequate resources and staffing, and coordination between the staff teams in the different components of the property are also essential.

INTERNATIONAL DESIGNATION

1980: Lago di Tovel in Brenta Natural Park designated a Ramsar Wetland of International Importance (37 ha)

IUCN MANAGEMENT CATEGORY

These protected areas are included within or overlap the nominated sites:

Parco Nazionale Dolomiti Bellunesi:	II National Park
Parco Naturale Provinciale Adamello Brenta:	V Protected Landscape
Parco Naturale Regionale Dolomiti d'Ampezzo:	V Protected Landscape
Parco Naturale Regionale Dolomiti Friulane:	V Protected Landscape
Parco Naturale Dolomiti di Sesto:	V Protected Landscape
Parco Naturale Fanes-Serres-Braies:	V Protected Landscape
Parco Naturale Prov. Panareggio & Pale di San Martino:	V Protected Landscape
Parco Naturale Püez Odle:	V Protected Landscape
Parco Naturale dello Sciliar:	V Protected Landscape
Riserva Nazionale Vette Feltrine:	IV Habitat/Species Management Area
Riserva Nazionale Monte Pavione:	IV Habitat/Species Management Area
Riserva Naturale Somadida:	IV Habitat/Species Management Area
Riserva Naturale Monte Pelmo:	Unassigned

BIOGEOGRAPHICAL PROVINCE

Central European Highlands (2.32.12)

GEOGRAPHICAL LOCATION

The site is a series of nine related mountain massifs in northeastern Italy near the Austrian border, in the regions of Trentino-Alto Adige, Friuli-Venezia Giulia and Veneto and the provinces of Belluno, Bolzano, Trento, Pordenone and Udine. They lie between 65 and 140km north of Venice and extend some 150km from east to west by 75km from north to south. Except for the western Brenta group and the eastern Friulane group, they are bounded on the west by the River Adige, on the north by the

River Rienza (Val Pusteria), on the south by the Rivers Brenta (Val Sugana) and Piave, and on the east by the River Piave. They are located between 10°54'09"N - 12°30'13"N and 46°09'5"E - 46°36'47"E.

Site	Longitude	Latitude	Province	Region
1. Pelmo Croda da Lago	N 12°06'49"	E 46°26'52"	Belluno	Veneto
2. Marmolada	N 11°51'23"	E 46°25'54"	Trento, Belluno	Trentino- Alto Adige / Sudtirol Veneto
3. Pale di San Martino - San Lucano Dolomiti Bellunesi - Vette Feltrine	N 11°59'39"	E 46°14'51"	Trento, Belluno	Trentino- Alto Adige / Sudtirol Veneto
4. Dolomiti Friulane / Dolomitis Furlanis e d'Oltre Piave	N 12°30'13"	E 46°20'48"	Pordenone, Udine Belluno	Friuli- Venezia Giulia Veneto
5. Dolomiti Settentrionali / Nördliche Dolomiten	N 12°09'47"	E 46°36'47"	Trento, Bolzano Belluno	Trentino- Alto Adige / Sudtirol Veneto
6. Puez - Odle / Puez - Geisler / Pöz - Odles	N 11°48'24"	E 46°36'13"	Bolzano	Trentino- Alto Adige / Sudtirol
7. Sciliar - Catinaccio / Schlern - Rosengarten - Latemar	N 11°36'10"	E 46°27'16"	Trento, Bolzano	Trentino- Alto Adige / Sudtirol
8. Rio delle Foglie / Bletterbach	N 11°25'14"	E 46°21'37"	Bolzano	Trentino- Alto Adige / Sudtirol
9. Dolomiti di Brenta	N 10°54'09"	E 46°09'51"	Trento	Trentino- Alto Adige / Sudtirol

DATES AND HISTORY OF ESTABLISHMENT

Component protected areas included within or overlapping the nominated sites

Component protected areas included within or overlapping the nominated sites:

- 1972: Riserva Naturale Somadida (Cadini) designated;
- 1974: Parco Naturale dello Sciliar designated;
- 1975: Riserva Naturale Vette Feltrine designated;
- 1975: Riserva Nazionale Monte Pavione (Vette Feltrini) designated;
- 1977: Parco Naturale Puez Odle designated;
- 1980: Parco Naturale Fanes-Serres-Braies (D. Settentrionali) designated;
- 1981: Parco Naturale Dolomiti di Sesto designated;
- 1988: Parco Naturale Panareggio & Pale di San Martino designated;
- 1996: environmental plan approved;
- 1988: Parco Naturale Adamello Brenta designated; 1999: environmental plan approved;
- 1988: Parco Nazionale Dolomiti Bellunesi designated; 1993: established;

2001: environmental plan approved;
 1990: Riserva Naturale Monte Pelmo designated;
 1990: Parco Naturale Dolomiti d'Ampezzo designated; 1999: environmental plan approved;
 1996: Parco Naturale Dolomiti Friulane designated.

LAND TENURE

92.7% of the core areas and 87.5% of the buffer areas are in public ownership, national, regional, provincial and municipal. Boundaries largely follow those of existing protected areas, Natura 2000 sites or the 1,600m contour.

Sites	Ownership
1. Pelmo Croda da Lago	Public: 96.4% including <i>regole</i> . *
2. Marmolada	Public: 99.2%
3. Pale di San Martino - San Lucano - Dolomiti Bellunesi Vette Feltrine	Public: 98.1%
4. Dolomitis Friulane e d'Oltre Piave	Public: 99.5%
5. Dolomiti Settentrionale Nördliche Dolomiten	Public: 88.4% [Sett Sass Private: approx. 30%]
6. Puez - Odle / Puez-Geisler / Pöz-Odles	Public: 70%
7. Sciliar-Catinaccio / Schlern-Rosengarten - Latemar	Public: 92.6%
8. Rio delle Foglie / Bletterbach	Public: 100%
9. Dolomiti di Brenta	Public: 99.4%

* Public property includes municipal domain, *regole* (community forest and pasture joint ownership administrations), mountain communities and collective landholders.

AREAS

The total area of the core zones is 141,902.8 ha. The buffer zones total 89,266.7 ha.

Component Sites	Area of Core Zone (ha)	Area of Buffer Zone (ha)
1. Pelmo Croda da Lago	4,343.6	2,427.3
2. Marmolada	2,207.5	578.0
3. Pale di San Martino - San Lucano - Dolomiti Bellunesi - Vette Feltrine	31,665.7	23,668.9
4. Dolomiti Friulane / Dolomitis Furlanis e d'Oltre Piave	21,460.6	25,027.6
5. Dolomiti Settentrionali / Nördliche Dolomiten	53,586.0	25,182.3
6. Puez-Odle / Puez- Geisler / Pöz-Odles	7,930.3	2,863.5
7. Sciliar-Catinaccio / Schlern-Rosengarten - Latemar	9,302.1	4,770.7
8. Rio delle Foglie / Bletterbach	271,6	547,4

9. Dolomiti di Brenta	11,135.4	4,201.0
TOTAL AREA (ha)	141,902.8	89,266.7

ALTITUDE

- 400m to 3,343m (Punta Penia in the Marmolada).

PHYSICAL FEATURES

The Dolomites form a grid on the southeastern margin of the Alps of some 50 spectacularly eroded massifs separated by deep valleys. They stand on a major watershed between Austria, drained by the Danube, and the Venetian hinterland, draining to the Adriatic. Except for the outlying Grappa di Brenta they are contained within the eastern catchment of the upper Adige and Isarco rivers (which forms the main highway from Bavaria), the western catchment of the upper Tagliamento and Meduna rivers and the whole of the intervening upper catchments of the Piave and Brenta rivers. There are 42 peaks over 3,100m and 90 between 2,200m and 3,100m. The dolomite of the region is mainly expressed in the large-scale landscape of disintegrating craggy mountains. Their rusty ochre, buff or grey-white peaks, massive pinnacles and cliff walls of layered sediments rise vertically 1,000-1,500 metres above huge cones of scree and strongly contrasting forests, fertile valleys and alpine pastureland. Forest, woodland and pasture comprise a quarter of the area, conifer forest grassland and heathland scrub, another quarter, and 40% is mountain crags, snowfields, boulders and scree. This dramatic scenery is scored by ravines, high glaciated valleys, waterfalls and streams, is of exceptional beauty and the nine sites of the property encompass most of the significant landscape features and geological values of the Dolomite region as a whole.

The geology is superbly exposed, especially for the Mesozoic period. The peaks are the resistant remnants of a long series of ancient marine deposits subsequently changed to fine-grained calcium magnesian carbonate or dolomite, a rock named after its scientific discoverer, de Dolomieu. These were laid down as coral reefs or intertidal shores in a series of shallow seas, with some deeper basins, formed by the slow subsidence of the land on the margins of the Tethys Ocean and they permit accurate reconstruction of the evolution of a passive continental margin. The deeply dissected mountainsides show in section an almost continuous sequence from the upper Permian to the Cretaceous periods of some 30 varied sedimentary deposits interlayered with the darker volcanic strata of magmatic intrusions. They lie on a late Palaeozoic basement of metamorphic and igneous rocks, seen in the quartzite porphyry of the western ranges which record the global mass extinction which occurred at the Permian-Triassic boundary. West of the Cordevole-Badia valleys the basement experienced volcanic activity and subsidence in the Permian; east of it, there was a continuous larger subsidence unaffected by magmatism. The rocks have since been relatively little disturbed and so preserve a sectional history of life forms from 270 million to 25 million years ago, including fossils and dinosaur footprints. These are especially revealing for the carbonate platforms or 'fossil reefs' of the Triassic period 220 million years ago when the 1,000m thick *Dolomia Principale* that now forms most of the outcrops was laid down, and there are several geological type sections in the property such as the Ladinian stage of the middle Triassic on the Marmolada which is in the Ladino speaking area of the Dolomites. After about 10 million years, following tectonic subsidence, the area was covered by a deep sea over the whole Carboniferous period.

The area's geomorphology is celebrated for its wide variety of types of terrain and the dynamic processes which it reveals. 40 million years ago, during the Alpine orogeny, the area was lifted, then eroded by glacial action along its many tectonic faults and strata until 15,000-10,000 years ago. The volcanic and other rocks eroded faster than the dolomite, resulting in a stark landscape of some 70 small glaciers and snowfields, wide U-shaped and hanging valleys, cirques and glacial debris. Steep slopes and sheer walls, high pinnacles, balcony ledges, huge skirts of scree, many colors and fantastic mountain profiles are characteristic. The area is a major source of water for northeastern Italy, and there are several dams, the most notable being the Vajont dam in the Friulani where in 1963 a landslide displaced the reservoir into the valley below, drowning 2,000 people. Thirteen ranges have been selected for designation, in nine main groups, with two outliers, one east and one west. The chosen massifs exemplify the formation and character of the mountains, the dominating geological characteristic of which is a combination of a thick relatively coherent deeply dissected slab of pale dolomite thrust over a dark platform of Permian volcanic and Hercynian basement rocks, least

tectonically deformed in the mountains east of Bolzano. The geomorphology of most sites shows glacial and periglacial features, dynamic slope processes and karst rocks, whose contrasting colors intensify under changing light. The range of microclimatic conditions and variety of soils has also given rise to great biodiversity. The following briefly summarises the key features of each site.

Site	Key Features
1. Pelmo - Croda da Lago	<ul style="list-style-type: none"> • Dramatic landscape with wide range of landforms including towers, plateaux, ledges and landslides, and evidence of the last glacial maximum. • Late Permian to early Jurassic succession, with rock and fossil records, tectonic and sedimentological, across an interval of c.100 million years
2. Marmolada	<ul style="list-style-type: none"> • Includes the highest summit of the Dolomites (3,343m), known as the Queen of the Dolomites”, a rocky massif with high relief and vertical walls. • Geological record of the Triassic sedimentary platform and overlying volcanic sediments
3. Pale di San Martino- San Lucano- Dolomiti Bellunesi- Vette Feltrine	<ul style="list-style-type: none"> • Horseshoe-shaped site with typical dolomite landscapes including cliffs, plateaux, valleys, pinnacles and walls. • One of the most complete stratigraphic series of the Dolomites from early Palaeozoic to the Cretaceous.
4. Dolomiti Friulane / Dolomitis Furlanis e d’Oltre Piave	<ul style="list-style-type: none"> • Many sheer rock walls, pinnacles, towers and valleys. • Stratigraphic succession dominated by dolomitic-calcareous rocks with repeated stratigraphy due to faulting.
5. Dolomiti Settentrionali / Nördliche Dolomiten	<ul style="list-style-type: none"> • Extensive areas of mountainous topography. Three main mountain groups, with major plateaux in the northwestern part and rocky cliffs further south. • The most complete stratigraphic sequence of the Dolomites, with three-dimensional exposures of carbonate platforms. • Fossil records of international significance documenting recovery of life after the Permian-Triassic extinction; includes important reef and plant fossil remains.
6. Puez-Odle / Puez- Geisler/ Pöz-Odles	<ul style="list-style-type: none"> • Two large dolomite plateaux isolated by sheer escarpments having some of the highest peaks of the Dolomites, and displaying a typical dolomite landscape. • Well preserved stratigraphic succession with little deformation, and internationally important stratigraphic and fossil-bearing horizons.
7. Sciliar-Catinaccio / Schlern- Rosengarten Latemar	<ul style="list-style-type: none"> • Wide variety of landforms with sheer dolomite peaks and high relief. • Key Triassic stratigraphic and palaeontological localities, including the Latemar Reef exposure of an isolated carbonate platform, subject of many international studies.
8. Rio delle Foglie / Bletterbach	<ul style="list-style-type: none"> • Deep and meandering gorge, creating the important geological exposure that is the key value of this component. • Well exposed succession of Permian-Triassic rocks, particularly important for documenting Permian palaeoenvironments, with trace fossil remains of vertebrate life at that time.
9. Dolomiti di Brenta	<ul style="list-style-type: none"> • Spectacular structural and climatic landforms including rock towers, steeples, ledges, cirques, landslides and a well developed karst system. • Extensive exposures document the structural and stratigraphic evolution of the south alpine passive margin and the tectonic history of the Dolomites.

CLIMATE

The climate is temperate with microclimates varying considerably with altitude and orientation to the sun. The mountain climate is cool temperate to 1,300m (north-facing) or 1,500m (south-facing); cold temperate to 1,800m and 2,200m; and cold or tundra-like above 2,200m. The average annual temperature is 5-7°C in the valleys and 2-3°C at 2,000m, but will fluctuate markedly in summer between a minimum of 8°-12°C and a maximum of 20°-25°C. In winter it can fall to minus 20° or 30°C. The shadowed and drier valleys in the interior and north of the area have a more continental climate and temperature inversions can create cold air drainage sinks. Rainfall is between 700-1,200mm, falling heaviest in summer. It is lowest in the north, but in the southern valleys open to the influence of the Adriatic, can be 1,500-1,700mm. Snowfall varies between 0 and 450 cm in the valleys to 100-1,000 cm in the mountains. It is not abundant and in recent years there have been 4 to 6 weeks less snow than formerly, but it accumulates sufficiently to maintain the snowfields and the 70 existing small glaciers. However, the largest of these glaciers, the Marmolada, decreased by 48% between 1910 and 1999, and most of the others are shrinking. Winds tend to be down-valley by day, up-valley at night. The katabatic Fohn wind can jump temperatures overnight causing floods and the risk of avalanches. Climatic change may also be contributing to the natural process of mountain collapse.

VEGETATION

The flora of the Dolomites is not exceptional, but it is highly diverse, especially on the southern massifs. It contains 25% of the national flora, and, under the impacts of man and climatic change, is in continual evolution. The region's species total about 2,400 in some 150 plant associations. In the nominated area, excepting the valley floors, the total is 1,700 species: the Dolomiti Bellunesi alone has 1,350 species, a quarter of Italy's flora, and 55 forest types. This diversity is due to the region's marginal location on the border between the Alpine/Central European Highlands and the Balkan Highlands, and not far from the Middle European Forest and Mediterranean Sclerophyll biogeographic regions. Species from these contrasting biomes are often juxtaposed; many plants are also found at the limits of their distribution. During the last Ice Age the Dolomites became a refuge for northern plants and several relict Tertiary communities remain from that time, often in isolation on their massifs, which has tended to increase speciation and endemism. As the glaciers retreated, plants from further east moved in; subsequent human activity further fragmented the original flora and most accessible valleys have some invading alien species.

The main vegetation belts are Middle European, sub-Atlantic, Boreal and Alpine. The more accessible woods have been managed for centuries under Venetian regulations to ensure naturalistic forestry, preserving their natural variety. Throughout the mountains, Austrian and Scotch pines *Pinus nigra* and *P. Sylvestris* grow wherever the soils are suitable. Where fairly flat the altimontane level has been kept clear by grazing livestock in the past and in spring is vivid with annual flowers. Where the pasture is abandoned it reverts to forest where fertile, or to grasses and sedges where droughty, in both cases tending to replace rare species dependant on grazing with the natural flora. The alpine zone consists of moist meadows of sedges and grass, small lakes, peat bogs and moorland. The cliffs, rock fissures and screes harbour plants adapted to cold and drought. Several of the classic endemic flowers of the Dolomites are found at this level. Acid-soil plants grow where the bedrock is volcanic. Owing to diminishing use of the high meadows, and to the warming climate, the tree line (1,800m on warm dry slopes to 2,200m on colder moister slopes) is rising, increasing the biodiversity but driving out some 400 species of cold-adapted plants. This has become a useful local indicator of climatic change.

FAUNA

As with the flora, the fauna is not unusual, except for a wealth of invertebrate species, with 1,600 species of butterflies, including the *Parnassus apollo* (VU) butterfly, but it is very diverse due to the great number of different habitats, altitudinal levels and the region's pivotal biogeographic location. In 1961, Mancuzzi listed 7,000 species, but the total is now said to be one tenth of all the European non-marine fauna, or some 13,000 species. These fall into six distinct groups: endemic, glacial relict, boreo-alpine, steppe, alpine and thermophil. The endemic species include the black salamander *Salamander atra*, but are chiefly found amongst the beetles and other insects. The fragmentation of the land has encouraged speciation: a version of 'dolomite' is incorporated in the 26 specific names. The glacial relicts are found especially along the district's southern margin just out of reach of the former ice sheet. Some 200 boreo-alpine species are those pushed south by the ice flow but are now

found only here and in the far north of Europe. Species of steppe origin are sparse except amongst insects.

Mammals include the brown bear *Ursus arctos*, native to the Adamello range adjoining the Dolomiti Brenta, and returning naturally from the Balkans, but also re-introduced, northern jackal *Canis aureus*, marmot *Marmota marmota*, a steppe species, European lynx *Lynx lynx*, wildcat *Felis sylvestris*, chamois *Rubicapra rubicapra*, ibex *Ibex ibex* (reintroduced 1980s), mouflon *Ovis orientalis* introduced into the Dolomiti Bellunesi for the hunt, red deer *Cervus elephas* and roe deer *Capreolus capreolus*. The large avifauna includes griffon vulture *Gyps fulvus*, lammergeier *Gypaetus barbatus*, golden eagle *Aquila chrysaetos*, goshawk *Accipiter gentiles*, peregrine *Falco peregrinus*, capercaillie *Tetrao urogallus*, the much hunted black grouse *Tetrao tetrix*, hazel grouse *Bonasia bonasia*, Alpine chough *Pyrrhocorax graculus* and the cliff-living wallcreeper *Trichodroma muraria*. Amphibian, freshwater mollusc, reptile and insect numbers are high. Two major factors stand out. There is a continual evolution in the position of ecotones resulting from the diminished human use and disturbance of both valleys and alpine pastures. Climate warming also encourages the upward and downward spread of mountainside forests. These have encouraged a gradual recolonisation of the backcountry by large predators such as bear and lynx and jackal which were previously killed to protect the livestock.

CONSERVATION VALUE

This dramatically scenic region of mountains rising sheer above fertile valleys is outstanding for its great number of ecosystems, high biodiversity and endemism and for its variety of depositional facies and fossils, which display a vertical and horizontal history of the Triassic past. It is also gradually being recolonised by large carnivores, and the continual evolution of its ecotones form a useful measure of climatic change. The nominated sites lies within a WWF/IUCN Centre of Plant Diversity, and the Brenta contain a small Ramsar wetland.

CULTURAL HERITAGE

There is evidence of human occupation in Mesolithic times about 10,000 years ago during the warming that followed the last Ice Age. Some 300 sites have been found in the mountains, mainly seasonal hunting and herding camps near strategic passes and pools. The deep penetrable valleys were trading routes as well as being farmed, especially the wide valley of the upper Adige and Isarco which led through to southern Germany. This was always a marginal area where the Latin mountain dialect of Ladino, similar to Romansch further west and Friulan to the east, persisted between the German-speaking north and Italian south. Relics of pre-Roman and prosperous Roman farming settlements have been found as far north as Val Pusteria. In the 8th century the upper Adige valley was colonised by Bavarians and, in the 15th century, as the South Tyrol, came under Germanic feudal then Austrian imperial influence until 1918. There are records of land use in the valleys dating from over 1,000 years ago. The southern valleys were part of the hinterland of the Republic of Venice which from the 16th century drew up forest registers for the region, regulated naturalistic forestry management practices in the Piave valley and mined for minerals in Val Cordevole north of Belluno. The great artist Titian was born in Pieve di Cadore and some of his paintings show the Dolomites and their golden light. Notable visitors have included Durer and Goethe. The southern half was annexed by Italy in 1866 and in the late 19th and early 20th centuries, sightseeing, mountaineering and spa tourism became popular, and most of the last large animals were hunted to extinction. During World War I Italy fought Austria fiercely for three years through the mountains, leaving fortifications and other relics. The South Tyrol then became part of Italy as the Alto Adige though it remains predominantly Germanic in character. As the area has been so long and intensively settled there is a wealth of information about its culture and places.

LOCAL HUMAN POPULATION

The people of the Dolomites are culturally Germanic in the north, Italian in the south and Ladino in the centre, especially in the valleys around the Sella massif, Val Livinallongo, Val Badia, Val di Fassa and Cortina d'Ampezzo: the Alto Adige is 65% German, 30% Italian and 5% Ladino. In 2005, the nominated core areas were populated only by seasonal workers and visitors except for 15 permanent residents in the Dolomiti d'Ampezzo area and 154 in the buffer zones, mainly in the Dolomiti Bellunesi. Historically, apart from the mining valleys, which are no longer worked, the mountain population was always poor, depending on seasonal farming, forestry and herding when the high summer pastures were used. With the 20th century growth of tourism, especially of skiing after World

War II, this has become the main regional source of income, though the returns to the local people have been modest considering the number of visitors. Many pastures were abandoned and the native rural culture began to decline though it remains of considerable interest to visitors.

VISITORS AND VISITOR FACILITIES

The area began to attract English and German admirers of the sublime from 1837 when two influential guidebooks were published. After the 1864 publication of *The Dolomite Mountains* by Gilbert & Churchill it became widely known by its present name. From November to May much of the area is inaccessible but it receives a million winter visitors a year for skiing and cross-country snow trekking. There are 450 ski lifts and wide areas of piste with 1,200 km of runs, though few in the nominated sites which exclude the ranges most affected by tourism such as the magnificent Sella massif because of its degree of tourist development. Cortina d'Ampezzo and Madonna di Campiglio are known nation- and world-wide as fashionable resorts. The Dolomiti Friulani, being relatively untouched by use, is retained as wilderness.

During the summer season from June to September there are 4 million annual visitors who come for mountain trekking, rock climbing, geotourism, mountain biking and horseback riding. The region has some 5,000 km of mountain trails, most well maintained, which cater for both serious hikers and for the tourist crowds at lower levels. Trails are also designed for touring relics of the First World War and through the former alpine pastures. There are well-used cableways up both the Tofana and the Marmolada. Within the core and buffer areas there are over 33 mountain cabins and 65 shelters, totalling over 3,000 beds in spartan conditions. The standards and condition of many of these facilities are monitored and maintained by the Italian Alpine Club to limit constant encroachment by litter and trampling. The many local villages and towns also provide thousands of beds and all the necessary services. There is plentiful information from books, maps and informed tour operators. 60 local museums are listed in the nomination, including a museum to the memory of the Great War and two recent museums of Ladino culture. Venice itself is only 65km south.

SCIENTIFIC RESEARCH AND FACILITIES

Dolomite was first noted here in 1789 by the geologist de Dolomieu after whom N. de Saussure named the rock and the mineral on its identification as magnesium carbonate. Research into its flora and fauna started in the 18th century, and the area was visited by the scientists Goethe, G. Arduino, L. von Buch, A. von Humboldt and E.von Mojsisovics. Most of the intensive work on the rocks and fossils was done by 19th century Austrian and German scientists, notably the geologist F.von Richthofen. The scientific distinction between intrusive and sedimentary rocks was first determined here. The quantity and concentration of extremely varied limestone formations and the clarity of its Mesozoic exposures and stratigraphy established the region's reputation as a world reference site for palaeontological, palaeo-environmental, stratigraphic, mineralogical and geomorphological research, especially for the late Permian and early Triassic periods. Due to the relatively undeformed clarity of its vertical and horizontal layering, the exposures form an ideal field laboratory which has attracted many university and research institutes to establish stations and monitoring sites. Each of the three provincial authorities is sponsoring extensive monitoring (in 75 studies) of species such as of the golden eagle and game birds, ungulates and small mammals, glaciers, the recolonising of pastures, the impacts of hunting and tourism, and surveys in support of the European Natura 2000 management plan. Many sections and aspects of the region have been minutely investigated and discoveries are still being made. The original nomination cites over 1,100 relevant references.

MANAGEMENT

The main aims of managing the area are to support its sustainable use, especially for tourism, and to promote popular understanding of conservation while conserving the integrity of its natural heritage. Only the most pristine half of the distinctive dolomitic mountain groups is therefore included in the nomination. Of these sites, even the buffer zones are in very good condition with most major tourism-related infrastructure excluded from the sites. Nearly all the component sites are protected as national or provincial Nature Parks but agreement on protective measures and consistent monitoring will be essential to success. However, below the national government level, the area is governed through a historically entrenched complex of jurisdictions. These are the autonomous provinces of Bolzano and Trento comprising the region of Trentino-Alto Adige; the provinces of Udine and Pordenone which comprise the region of Friuli-Veneto Giulia which has some autonomy; and the province of Belluno which is part of the region of the Veneto and is less independent of regional

control. Strategic and coordination plans are being separately prepared by each province. This series of sites has therefore been made subject through an inter-provincial Coordinating Committee to a Programme Agreement to harmonise the legal instruments and protective strategies of each province in a Management Framework for an eventual Management Plan for the whole area. Its purpose is to promote the local economies at the same time as promoting awareness of the heritage values especially of the grazed and wilderness landscapes; also to ensure monitoring of the scenery, geology, palaeontology, mineral resources, visitor numbers, impacts and hazards. However, it does not legally override the well-guarded traditional customs and regulations of the four cultural groups or the protective measures of any of the three regions, five provinces and many municipalities already in place.

The area is well protected though this entails considerable legal complexity. Four of the component sites lie in a single province; three are in two provinces with differing regulations; and two are in three provinces. 71% of the nominated area is protected within a national park or a provincial nature park; 94% is protected as a Site of Community Importance and 83% as a Specially Protected Zone both within the Natura 2000 network of the European Union under its Habitats (92/43/EEC) and Birds (79/409/EEC) Directives. National legislation covers hydrogeological restrictions (RLD 3267 of 1923), protected areas (Law 394 of 2001); the protection of warm-blooded wild fauna, and hunting quotas (Law 157 of 2002). The national code protects cultural heritage and landscape (article 142 of 2004), modified in March 2008 to extend protection to areas above 1,600m. Specific protective regulations are applied through an array of 64 regional and provincial laws (12 for Trento, 7 for Bolzano, 16 for Belluno and 29 for Friuli-Venezia Giulia). These regulations are enforced over-all by the National Forestry Corps or, in Pordenone-Udine, by the Regional Forestry Corps, the local police and *regole*, and National and Natural Park authority rangers, aided by gamekeepers. The Rio delle Foglie/Bletterbach site is protected as a provincial natural monument. Commissions for landscape protection and environmental surveillance oversee plans and work projects. Typical of the many protective regulations within the core areas are bans on hunting, firewood cutting and unsupervised forestry, on the collection of plants and wild animals, on new roads for tourist use, on unlicensed off-road driving and the use of snowcats off-piste; also rules for the use of traditional materials, the scale of new buildings and other items of tourist infrastructure.

Regular monitoring is conducted of climate, tourist numbers and impacts, the state of popular trails, unstable slopes, water quality and the areas of glaciers as an index of changing climate; also of the condition of key environments where animals such as black grouse, hares or golden eagles can indicate the presence or degree of hunting and disturbance; and of the quality of the landscape. For instance, the abandonment of high altitude herding and the reduction in woodland management and disturbance at high levels is resulting in the spread of scrub, of forest both up and down the slopes, some loss of rare plant species and communities and the gradual return of large carnivores. Repairs, especially to the many networks of trails, are continuous. Potential landslide areas are carefully mapped and monitored.

MANAGEMENT CONSTRAINTS

The multiple jurisdictions and management regimes of the property make it essential that the interprovincial management, monitoring and reporting is well coordinated, adequately staffed and well resourced to avoid compromising its integrity. The leading challenges to preserving the quality of the area come from tourism, its main source of revenue, which in places comes near the acceptable World Heritage limits of tolerance. Winter skiing apparatus and facilities are intrusive and are one reason for the exclusion of handsome landscapes such as the Sella massif from the nomination, although the cable cars on the Marmolada and the Tofane in the Northern Dolomites are considered acceptable in scale. There is overuse of the land in summer by trampling tourists, and of water, especially for winter snow-making. Trampling, especially on the first 200 metres of trails between about 1,500 and 2000m, and off-trail at higher levels, leads to the invasion by alien species at the expense of vulnerable native plants. However, the higher areas are protected by inaccessibility. The disposal of litter and human waste at shelters and cabins remains a challenge. The discontinuation of pasture rotation and shepherding has led to overgrazing and the loss of flowering Alpine meadows. The introduction of alien animals can also be undesirable, such as the displacement of the native brown trout by an alien trout. Although each province has responsibility for and a strategy for tourism, there are no unifying plans for sustainable tourism or for an effective management system over the whole area at present.

Flooding and landslips like the occasional collapse of unstable rock slopes and pillars, and also fire, are natural hazards, but many threats are lessened by sound forestry practices: clear-cutting of slopes has traditionally been illegal for this reason. A Ministries' Committee for Land Protection works with local governments to coordinate their data on landslides. 695 ha are presently glaciated. The changing climate has nearly or completely extinguished 14 of the 74 glaciers existing in 1900. Land tenure can be problematic. Much land is fallow as a result of depopulation during the 20th century, leaving much ownership unknown; the continual subdivision of lands between heirs under Roman law also leaves many parcels too small to use. This does not apply in the Germanic region where primogeniture is the norm.

COMPARISON WITH SIMILAR SITES

The main bases for comparison with similar existing World Heritage temperate limestone mountain sites are:

- (vii) The exceptional scenic beauty of highly eroded peaks above the high pastures and farmed valleys
- (viii)
 - The diversity of its geology and geomorphology, and the resulting high number of microhabitats;
 - The completeness, length and clarity of the Triassic marine fossil record;
 - The present integrity of the mountains, and potential for effective maintenance;

The salient character of these mountains is the dramatic scenery of the many jagged massifs of disintegrating dolomite of varying form and colour, along with their stratigraphic record and glaciers. There are in the Alps three other World Heritage mountain sites: Swiss Alps Jungfrau-Aletsch, an embedded granite massif with the largest glacier in Europe but containing no notable fossils, Swiss Tectonic Arena Sardona, a largely crystalline area of overthrust, and Monte San Giorgio, a low wooded mountain with some exceptional middle Triassic marine fossils. Other World Heritage mountain sites of temperate climate karst in Europe include Durmitor, the Pyrenees-Mont Perdu, Pirin and the West Caucasus; in China Mounts Wulingyan and Emei, South China Karst, the Sichuan Giant Panda Sanctuaries, and Huanglong and Jiuzhaigou; and in America, the Canadian Rockies and Waterton-Glacier Park.

In Europe there are scenically comparable karstic sites though less varied and dramatic, in Durmitor and the Pyrenees. They are without notable fossils though the Durmitor limestone does reveal a remarkable stratigraphic sequence. Amongst these, the Dolomites have the largest number of plants and vertebrates. There are several limestone mountain sites in China, usually more wooded than the Dolomites, but most are not closely comparable except perhaps for the spectacular partly sandstone pillar peaks of Wulingyan which also have Permian-Triassic fossils, and, in extent, the mountainous giant panda sanctuaries in Sichuan. The South China Karst has a most striking array of karst formations, the travertine forms of Huanglong and Jiuzhaigou are in scenic wooded mountain valleys, Mount Emei is a single forested massif. The renowned scenic mountain of Huangshan is predominantly granite.

The huge, high and very scenic Canadian Rocky Mountain Parks, contain the famous Precambrian fossils of the Burgess shale in Yoho Park but are more a continuous wall of mountains than a network of ranges. Waterton-Glacier Parks between Canada and the U.S. have superb scenery and biodiversity though their fossils are of less importance in their nominations. The great gorge of Nahanni in Canada is in sandstone. Few of these exceptionally scenic sites, except perhaps Durmitor and Wulingyan, are comparable landforms. The famously scenic mountains of the Drakensberg, Yosemite or Canaima for instance are of volcanic, plutonic and sandstone origin respectively.

The wide extent of highly eroded peaks of the Dolomites is exceptional for a combination of qualities: the variety and vivid contrast of light-coloured massifs and pinnacles with the meadows, forests and open valleys below, the long succession of Permian to Cretaceous fossiliferous sediments, exposing a vertical history of the past, and the biodiversity and many microhabitats resulting from their pivotal biogeographic location. In addition there are Venetian records of land use over some 500 years. The comparisons with similar mountain sites are summarised in the Annex.

STAFF

Most of the administration, policing and maintenance falls to the provincial and municipal authorities for each area although the national forestry, water basin and environmental agencies assist with management. Overall coordination is most often done by the national or provincial forestry corps. Each province, municipality or regole provides services for the environment, countryside, agriculture, water resources, land and fauna protection and culture within their jurisdictions. Parks are governed and patrolled by the National and Natural Park authorities and rangers, and tourist enterprises also contribute staff. There is a Programme Agreement between the provinces to harmonise the varied managements of protected areas in a Management Plan but at present it is advisory.

BUDGET

Each administration contributes funding which is to be harmonised in future through the Programme Agreement and within the Management Framework. An annual budget of €400,000 (US\$510,000) will be provided, with an additional €200,000 for the first year, spread over all five provinces. More finance may become available through programs sponsored by the EU.

LOCAL ADDRESSES

Provincia di Belluno

President of the Province, Via S. Andrea, 5, 1-32100 Belluno.

Servizio Urbanistica, Via S. Andrea, 5, 1-32100 Belluno.

Provincia Autonoma di Bolzano

President of the Province, Palazzo 1, Via Crispi, 3, I-38100 Bolzano.

Ripartizione Naturae Paesaggio, Ufficio Parchi Naturali, Via Renon, 4, 1-39100 Bolzano.

Provincia di Pordenone

President of the Province, Largo San Giorgio, 12, 1-33170 Pordenone.

Servizio Pianificazione del Territorio, Largo San Giorgio, 12, 1-33170 Pordenone

Provincia Autonoma di Trento, President of the Province, Piazza Dante, 15, 1-38100 Trento.

Dipartimento Urbanistica e Ambiente, Via Jacopo Aconcio, 27, 1-38100 Trento.

Provincia di Udine

President of the Province, Piazza Patriarcato, 3, 1-33170 Pordenone.

Area Tecnica, Piazza Patriarcato, 3, 1-33100 Udine

Regione Autonoma Friuli Venezia Giulia

President of the Province, Via Carducci, 6, 1-34133 Trieste

Direzione Centrale Risorse, Via Caccia, 17, 1-33100 Udine

REFERENCES

The principal sources for the above information were the original nominations for World Heritage status. The bibliographies cite 1) 60 references + 1,100 further references; 2) 223 references.

Bosellini, A. (1996). *Geologia delle Dolomiti*. Casa Editrice Athesia, Bolzano, 192 pp.

Bosellini, A., Gianolla, P. & Stefani, M. (2003). Geology of the Dolomites. *Episodes* 26: 181-185.

Carton, A. & Soldati, M. (1993). Geomorphological features of the Dolomites (Italy). In: Panizza, M., Soldati, M. & Barani (eds.), *Proceedings: 1st European Course on Applied Geomorphology*. Univers., Modena. 13-29

Cassol, M., Gianolla, P., Lasen, C., Viola, F., Bosellini, A. & Minelli, A. (2006). *Nomination of the Dolomites for Inscription on the World Natural Heritage List, UNESCO*. For the Provinces of Belluno, Bolzano, Pordenone, Trento & Udine. 505 pp.

----- (2007). *Nomination of the Dolomites for Inscription on the World Natural Heritage List, UNESCO. Integrations to the IUCN Evaluation*. For the Provinces of Belluno, Bolzano, Pordenone, Trento & Udine. 33 pp.

De Battaglia, F. & Marisaldi, L. (2000). *Enciclopedia delle Dolomiti*. Zanichelli Editore, Bologna.

Dingwall, P., Weighell, T. & Badman, T. (2005). *Geological World Heritage: A Global Framework*. Protected Area Programme, IUCN, Switzerland.

Price, M. & Bomhard, B. (2009). *World Heritage Nomination IUCN Technical Evaluation, The Dolomites (Italy)*. IUCN, Gland, Switzerland.

Provinces of Belluno, Bolzano-Alto Adige, Pordenone, Trento & Udine (2008). *Nomination of the Dolomites for Inscription on the World Natural Heritage List, UNESCO*. 367 pp. [Contains two bibliographies with 238 references]

Soldati, M, Corsini, A. & Pasuto, A. (2004). Landslides and climate change in the Italian Dolomites since the Lateglacial. *Catena* 55 (2): 141-161.

Touring Club Italiano (2000). *Parks in the Dolomites. Tourist guide. 1:200.000*. Touring Editore, Milano.

Wong, T. *et al.* (2001). *Proceedings of the Asia-Pacific Forum on Karst Ecosystems and World Heritage*. Gunung Mulu, Sarawak, Indonesia.

Zandonella C. (2001). *I Dolomiti*. Casa Editrice Panorama, Trento.

DATE

August 2008. Updated 10-2009, May 2011.