ARL
ACADEMY FOR
TERRITORIAL DEVELOPMENT
IN THE LEIBNIZ ASSOCIATION

Forschungsberichte der ARL 18

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Hanover 2021

The manuscripts of the papers included in this volume have undergone peer review (external quality control). After the referee's comments were taken into account they were then submitted to the ARL HQ for further editing and publication. Academic responsibility for the papers rests with the authors.

ARL HQ:
Prof. Dr. Andreas Klee (klee@arl-net.de)

Forschungsberichte der ARL 18

ISBN 978-3-88838-107-2 (PDF version)
ISSN 2196-0461 (PDF version)
The PDF version is available at shop.arl-net.de (open access)

ISBN 978-3-88838-108-9 (print version)
ISSN 2196-0453 (print version)
Printed by: Books on Demand GmbH, 22848 Norderstedt

Published by the ARL – Hanover 2021
ARL – Academy for Territorial Development in the Leibniz Association
Typesetting and layout: ProLinguo GmbH
Translation and proofreading: ProLinguo GmbH

This reserach report is a translated version of the following publication:
Job, Hubert; Mayer, Marius; Haßlacher, Peter; Nischik, Gero; Knauf, Christoph; Pütz, Marco; Essl, Josef; Marlin, Andreas; Kopf, Manfred; Obkircher, Stefan (2017):
Analyse, Bewertung und Sicherung alpiner Freiräume durch Raumordnung und räumliche Planung.
Hannover. = Forschungsberichte der ARL 7.

Recommended citation:
Job, Hubert; Mayer, Marius; Haßlacher, Peter; Nischik, Gero; Knauf, Christoph; Pütz, Marco; Essl, Josef; Marlin, Andreas; Kopf, Manfred; Obkircher, Stefan (2021):
Analysing, assessing and safeguarding Alpine open spaces through spatial planning.
Hanover. = Forschungsberichte der ARL 18.
URN: https://nbn-resolving.org/urn:nbn:de:0156-083914

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Acknowledgements

The authors would like to thank the Academy for Territorial Development (ARL) for its financial and logistical support for their research project. Special thanks are due to Prof. Dr. Andreas Klee and Prof. Dr. Ingo Mose for their support in the conceptualisation and preparation of this volume. We are also indebted to the following: Constanze Becker, PD Dr. Oliver Bender, Thomas Bläser, Prof. Dr. Tobias Chilla, Bernhard Hefinger, Dr. Roland Kals, Prof. Dr. Felix Kienast, Dr. Kurt Kußtatscher, Dr. Klaus Lintzmeyer, Dr. Gottfried Schindlbauer, Dr. Konrad Stockner, Dr. Thomas Philipp Streifeneder, Dr. Sabine Weizenegger, Henning Werth.

In memory of the two recently deceased, distinguished Alpine researchers and co-founders of applied geography: emer. o. Univ.-Prof. Dr. phil., Dr. h.c. mult. Elisabeth Lichtenberger, Vienna (d. 14 February 2017), full member of the Austrian Academy of Sciences, and emer. o. Univ.-Prof. Dr. rer. nat., Dr. h.c. Karl Ruppert, Munich (d. 29 March 2017), member of the ARL.

1 Introduction

With the ecosystem services they provide, including provisioning services (e.g. as a source of water and wood), regulating services (e.g. groundwater filtering), cultural services (e.g. scenery) and supporting services (e.g. soil formation), the Alps are well known as a natural area of tremendous importance. As a complex ecosystem exploited by humans for millennia, however, they are more than merely a contiguous natural area with a high degree of floral and faunal diversity. With regard to recent morphological processes, their pronounced relief as a young folded mountain range also makes them an excellent climate indicator. In addition, they act as a continent-wide supplier of resources (water reservoir) and as a source of regional identity, i.e. as a living environment and recreational area with long-standing methods of cultural landscape management, diverse traditions and the characteristic lifestyles of the people who call it home. Last but not least, they are a global tourist destination (Goppel 2003: 119; Köhler 2003: 61; Mayer/Kraus/Job 2011; Bätzing 2015a). In public debate, the Alps are thus subject to the conflicting perceptions and demands of various social groups and public and private stakeholders (cf. Mayer/Job 2014 for the Bavarian Alps).

The motto of the Olympic Games, 'Citius, altius, fortius', is more fitting than ever for this indisputably expansive and magnificent tourist destination. In spite of the many unfavourable climate predictions for the long-term success of ski tourism (cf. Soboll/Dingeldey 2012; Soboll/Klier/Heumann 2012; Steiger/Abegg 2013; Abegg/Steiger 2016), substantial investments continue to be made in tourism facilities and services at Alpine winter sport sites every year (e.g. €570 million for the 2015–2016 winter season)[1]. However, this has long since been true not only for winter sports but for summer tourism as well, and the long-term consequences for people and the environment are often left unconsidered (cf. Job 2005; Haßlacher 2006; Steiger/Mayer 2008; Mayer/Kraus/Job 2011; Rupf/Wyttenbach/Köchli et al. 2011; Bätzing 2015a; Bätzing 2015b; Siegrist/Gessner/Ketterer-Bonnelame 2015; Haßlacher 2016a). Superlatives sell best, and previously undeveloped Alpine spaces continue to become mass tourism 'playgrounds' for outdoor sports.[2] New developments are still taking

1 https://www.wko.at/Content.Node/branchen/oe/TransportVerkehr/Seilbahnen/Infoblatt-Die-Seilbahnen-in-Zahlen.pdf (13 March 2017).

2 Ski resorts everywhere in the Alps are competing to be bigger, more luxurious and more exciting. €30 million were invested in a cable car in Sölden. Not far away in the Stubaital valley, €64 million were ploughed into the glacier snows for the Eisgratbahn cable car. This build-up is by no means limited to the ski runs. A glass building was erected to house a motorcycle museum at an elevation of 2175 m in Hochgurgl, and a 200 m "Thrill Walk" is nestled into the cliffs of the Schilthorn in Switzerland' (Pütz 2017: 72). In the interest of objectivity, it should be noted here that the cable cars mentioned in the quote are replacements at locations where cable cars had already been in place since 1948 and 1973, respectively. However, these replacements are worthy of mention due to their extremely high capacities (both are main access lines) and interior comfort. The motorcycle museum in Hochgurgl is on the road over the Timmelsjoch pass, which is very busy in the summer. On the other hand, tourism infrastructure is in retreat at other locations in the Alps, as shown by the closures of ski resorts in Austria (cf. Falk 2013). Ideally, these areas would then undergo restoration (cf. Dietmann/Spandau 1996).

place,[3] mostly for mergers of ski resorts (Alpbach-Wildschönau in 2012–2013, Arlberg West-Arlberg Ost in 2016–2017, both in Austria) and, after many years of restraint (Hockenhorngrat-Lötschental in 2003), once again in Switzerland, as shown by the recently approved linking of the Andermatt and Sedrun ski resorts via the Oberalp Pass scheduled for 2017–2018 as part of the Andermatt Swiss Alps Resort planned by the investor Samih Sawiris. The emphasis thus remains more on quantitative growth, with ski resorts becoming ever more homogeneous and interchangeable. Various observers now speak of a gentrification of ski runs (cf. Mayer/Hasenjäger 2016).

The general public often becomes aware of modifications to high-altitude Alpine landscapes such as those described above only when they are spectacular or controversial enough to attract attention from the media. An example of this is unquestionably the Riedberger Horn (1,787 m) in Germany's Oberallgäu region, currently the best-known mountain in Germany. Its case was reported in leading media such as *Der Spiegel, the Frankfurter Allgemeine Zeitung and Die Zeit* (cf. Clauß 2016; Fitzthum 2017; Meier 2017). The municipalities of Obermaiselstein and Balderschwang have been proposing for many years to connect the Balderschwang and Grasgehren ski resorts, but parts of their planned new railway and ski run would extend into Zone C of the Alpine Plan, which has been an established spatial planning objective of the Bavarian State Development Programme *(Landesentwicklungsprogramm, LEP)* since 1972. However, in accordance with this objective 2.3.6 of the Federal State Development Programme (2013), state spatial planning does not permit transport projects such as cable cars, lifts and ski runs in Zone C of the Alpine Plan (cf. Goppel 2012; Job/Fröhlich/Geiger et al. 2013; Job/Mayer/Kraus 2014). To undermine this standard and make the planned ski facility eligible for approval, the Bavarian cabinet recently resolved changes to the Alpine Plan's zone borders in the Federal State Development Programme.[4] This means there is now a concrete danger that for the first time since its inception, the Alpine Plan would be weakened by tourism related investment plans for transport development and due to the precedent thus established, would no longer provide strict protection against encroach-ments on the sensitive Alpine landscape of Zone C (Mayer/Strubelt/Kraus et al. 2016).

Further development, surface sealing and fragmentation with their attendant direct and indirect impacts on the limited space available for permanent settlements in the

3 Examples include the Versing monocable lift in See in Austria's Paznaun valley (2014), the Hirschbichl surface lift in the Austrian Hochzillertal ski resort (2015–2016), and the Daunjoch detachable chairlift at the Stubai glacier ski resort in Austria (2012–2013) (cf. lift-world.info; 12 March 2017).

4 The plans call for changes to Appendix 3 (of section 2.3.3) of the Alpine Plan in the Federal State Development Programme so that the area in Zone C of the Alpine Plan that is needed for the Riedberger Horn project (railway and ski run) – approximately 80 ha – would be allocated in future to Zone B of the Alpine Plan. In exchange, areas in Zone B covering 304 ha on the Bleicherhorn and the Hochschelpen (two mountains in the vicinity) will be allocated in future to Zone C (ordinance revising the ordinance on the Bavarian State Development Programme of 7 February 2017). However, this would mean surrendering one of Bavaria's last completely intact black grouse biotopes and simply ignoring the officially established landslide-prone geohazard areas in the local flysch deposits (Werth/Kraft 2015; *LfU* [Bavarian Environment Agency] 2015).

Alps[5] are now the norm in the tourist regions (*Rat für Nachhaltige Entwicklung* 2004; Baier/Czybulka/Erdmann et al. 2006; Job/Pütz 2006). However, it would clearly be shortsighted to identify tourism as the sole cause of problems involving the increasing development and fragmentation of open spaces in the Alps. The fragmentation of landscape units by tracks for forestry and seasonal pasturing is much more extensive and presumably more significant from a quantitative point of view than the construction of mechanical lifts (cf. Mayer/Strubelt/Kraus et al. 2016 for the Bavarian Alps), i.e. agriculture and forestry also contribute to the problems outside of the valleys. However, a critical examination of these development measures walks a very fine line as links between farms and pastures with roads suitable for vehicular use by Alpine farmers are considered essential to the continuation of this culturally desirable form of agriculture (Mayer/Job 2010).

It can thus be stated that while considerable pressure to exploit Alpine open spaces was already identified in the 1970s (Krippendorf 1975), it is stronger than ever today. In the general discussion about open spaces, the focus of interest is often on the valleys[6], whose population has increased over the years throughout the Alps (Bätzing 2015a; Bender/Roth/Job 2017). This study primarily considers the open spaces in outlying areas – in the Alpine context, regions at higher elevations than areas of permanent settlement. In terms of spatial planning (*Raumplanung*), the focus is thus on the areas where territorial stipulations to conserve open spaces close to settlements, such as in green zones, corridors and belts, tend to cease. This does not mean, however, that Alpine open spaces are always associated with higher altitudes. Ideally they stretch approximately to the lower edge of the continuous forest belt on the lower valley slopes. On the one hand, this prevents such open spaces from being topologically fixed in the area of the high-altitude 'worthless lands' where there are fewer conflicts (Job/Fröhlich/Geiger et al. 2013; Bender/Roth/Job 2017; Mayer/Mose 2017). On the other hand, this spatial extension into lower altitudes also does justice to the spatio-structural interlinkages between the 'real' Alpine region and the valleys (e.g. by forestry and seasonal pasturing tracks), not least with reference to winter tourism and the ski resorts (Haßlacher 2007a). This should also allow for a better connectivity of habitats between the mountain forests, high pastures and the 'barren lands' of the high Alps (Schoßleitner 2016).

The research area for this study is situated in the German-speaking Alpine region. The analysis thus considers the respective areas covered by the Alpine Convention in Germany, Austria (the federal states of Salzburg, Tyrol and Vorarlberg), Switzerland and Italy (the autonomous province of Bolzano-South Tyrol). These regions of the Alps are among those that are most intensively used and developed for tourism (Mayer/Kraus/Job 2011: 34). Here tourism is often the leading economic sector, especially in the high altitude, peripheral and sparsely populated valleys (Berwert/Rütter/Müller 2002). In general, there is also significantly greater and more sustained population and land-use pressure there than in other Alpine areas (Bätzing 2015a:

5 As an example, this fraction is 11.8% of the territory in Tyrol (cf. https://www.tirol.gv.at/statistik-budget/statistik/flaechennutzung; 12 March 2017).

6 Problems in the valleys in the vicinity of settlements, such as the issues involving second homes (Sonderegger 2014) or the expansion of roads (Haßlacher 2016d), are sometimes even more serious due to the generally small areas of permanent settlement.

304 et seq.). The subject of preserving as yet undeveloped Alpine landscape areas and areas little impacted by infrastructural development as open spaces thus seems particularly relevant. Furthermore, there are much greater similarities in culture, language, history, tourism offerings and spatial planning regulations in the German-speaking Alpine region than in the Romanic and Slavic Alpine regions (Bätzing 2015a: 60 et seq., 304 et seq.).

The development contest (to create the largest contiguous ski resort) between municipalities, valleys, regions and states makes it urgently necessary for a constructive discussion to be conducted across the Alpine region (Haßlacher 2016b: 9). In light of the worsening problems, spatial planning (*Raumordnung*) must regain its standing and significance in the Alpine states and take new approaches.[7] A balance between utilisation and open space must be agreed and adhered to by the various stakeholders active on various scales: from representatives of planning practice and planning science to non-governmental organisations and local residents. Associations such as the International Commission for the Protection of the Alps (CIPRA Germany 2016) call for a general international halt to the extensive expansion of ski resorts. This is too apodictic and short-sighted, and runs counter to the largely neoliberal attitude of present-day policy. A better understanding of spatio-functional structures is required, based on levels of intensity of use. Greater safeguarding of open spaces through spatial planning is required to provide conservation areas for people and nature. A new Alpine spatial planning architecture that also clearly defines areas for use is required (Mayer/Strubelt/Kraus et al. 2016; Haßlacher 2016c).

The conservation of open spaces in the Alps is relevant for the protection of natural heritage (biodiversity), the preservation of landscape aesthetics, the safeguarding of the ecosystem services that these areas provide, and the provision of classic landscape-related recreation. This must be guaranteed without unnecessarily restricting the economy and transport, because the Alps need to be preserved as a place where the local population lives and works. The spatial planning institutions should fulfil their present-day role of coordinating conflicting land-use functions in the Alpine region, and this work is intended to support that aim.

We begin by outlining the problems and the current state of research relating to Alpine open spaces and providing an overview of various substantively very divergent strategies for safeguarding open spaces (Section 2.1). These considerations are then used to formulate an independent and comprehensive definition of open spaces (Section 2.2). After explaining our research design and methodology (Chapter 3), we provide a classification of the supranational regulations for the entire Alpine region – the Alpine Convention and EUSALP (Chapter 4). We then describe the long-established instruments for the preservation of open spaces in the German-speaking Alpine region, focusing on the Bavarian Alpine Plan and quiet areas in Tyrol (Chapter 5). Further topics include four relatively recent approaches to preserving open spaces

7 The marginal role of spatial planning (*Raumordnung*) in the important monograph by Bätzing (2015a) shows that its scientific standing for the Alpine region is currently relatively low. The term is not even to be found in the work's index. Bätzing (2015b: 110) at least entrusts spatial planning (*Raumplanung*) with the role of limiting tourism development, which he suggests it can fulfil better than conservation areas.

that have not previously been implemented in spatial planning (*Raumordnung/-planung*); these are described and explained in detail. We then synthesise the various existing and new analyses, mainly in the form of a synoptic comparison and discussion of the differences and similarities of the various approaches (Chapter 6). We conclude by discussing and summarising the results and identifying remaining research gaps. Our aim is thus to harmonise and consolidate approaches to the conservation of open spaces in the German-speaking Alpine region and in particular to present options for planners to safeguard Alpine open spaces in general while at the same time assessing how they are currently handled in spatial planning (Chapter 7).

2 Open spaces

The aim of this work is to identify Alpine landscape areas that are undeveloped, semi-natural or little impacted by infrastructural development and to preserve them as open spaces. There are various ideas and strategies, both traditional and newer, relating to open spaces; this fact is underscored by diverse studies taking various approaches, with consequent differences in the terminology used. Terms like semi-natural open spaces, open areas, white zones, quiet areas, Alpine quiet areas, protected zones and others are used. These terms differ in their objectives but are often used synonymously or according to regional preferences, despite considerably differing definitions and delimitations (Baier 2006: 386; Häpke 2012: 14). All of this must be taken into account if an overarching understanding and a generally applicable definition of open space in the Alpine context is to be developed.

2.1 Current state of research

The basic function of open space is to preserve and safeguard the natural foundations of human life (soil, water, climate, air, landscape, flora and fauna) and the functionality of ecosystems (conservation and regeneration), which require a certain amount of open space (Ritter 2005: 336). More specifically, open space can be divided into three functions (BMVBS/BBR [Federal Ministry of Transport, Construction and Urban Development/Federal Office for Building and Regional Planning] 2006: i): ecological (e.g. landscape, species, biotope and soil conservation), economic (e.g. agriculture and forestry) and social (e.g. flood protection, immission control, recreation and landscape appearance). Increasing greenfield land take and its attendant loss of open space can lead to diverse negative consequences (cf. Chapter 1). Some examples include soil sealing, landscape fragmentation, habitat fragmentation (ecological consequences), and increased traffic volume or rising infrastructure costs (economic and social consequences) (Job/Vogt 2004: 852 et seq.; Schiller/Siedentop 2005: 83 et seq.).

First, to provide a broad definition as a basis for this publication and, where necessary, to differentiate that definition from earlier definitions, we present the existing concepts in the 'open space' constellation. For the present, the debate centres on the concepts of 'wilderness', 'landscape fragmentation', 'remote areas/remoteness', and 'ecological connectivity'. This is not an exhaustive selection; for example, we have omitted the older concept of 'unfragmented, low-traffic spaces' (e.g. cf. Fritz 1984: 284 et seq.).

The concept of 'wilderness' is as old as the term itself. However, the use of the term in the context of conservation areas is relatively new (cf. IUCN 2016: 5). The conservation debate in the United States – using the concept of 'wilderness' – initially emerged in 1924; the US Wilderness Act was adopted in 1964 and is the first piece of national legislation clearly defining wilderness areas (IUCN 2016: 5; Saarinen 2016: 2; *BfN* [Federal Agency for Nature Conservation] 2017: n.p.). The concept of wilderness '[...] was developed in the 18th and 19th centuries to contrast with the familiar

Central European cultural landscapes' (BfN 2017: n.p.), and evokes diverse interpretations (IUCN 2016: 2). Essentially, three meanings can be identified (IUCN 2016: 2):

> landscapes that are biologically largely intact, free of industrial infrastructure and largely free of disruptive anthropogenic impacts (biological indicator);

> wilderness protected areas as a protection category (IUCN Category Ib);

> an essential dimension of human culture (strong human bond with wilderness due to past lifestyles).

By way of example, Mittermeier/Mittermeier/Brooks et al. (2003: 10310 et seq.) have defined specific criteria for wilderness: such areas must have a minimum area of 10,000 km², a low population density (fewer than 5 people/km²) and an intact ecosystem. Defining wilderness is further complicated by the fact that the term is often used to paraphrase diverse personal perceptions of landscapes ranging from urban parks to extensive and nearly untouched areas (IUCN 2016: 2). Germany's Federal Agency for Nature Conservation defines wilderness areas as '[...] for the purposes of the National Strategy on Biological Diversity [...] (largely) undissected, unused areas of sufficient size, intended to permanently ensure natural processes to unfold undisturbed by human influences' (*BfN* 2017: n.p.). For example, Europarc Deutschland considers a minimum area of 1,000 ha to be sufficient for Central European wilderness areas, a figure critics view as wholly inadequate (Job 2011; Job/Woltering/Warner et al. 2016).

The International Union for Conservation of Nature (IUCN) added the concept of wilderness to its guidelines only in 1994. The guidelines name two categories: strict nature reserves (Ia) and wilderness areas (Ib). The latter are defined as 'usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, protected and managed to preserve their natural condition' (IUCN 2016: ii). These areas generally encompass larger regions, but also smaller ones in which the quality of the wilderness can be improved and the borders expanded (IUCN 2016: 2). Thus far it can be said that specifications concerning wilderness are mostly made at the national level, such that no uniform standards can be identified (IUCN 2016: 5). Strictly speaking, given its high population density, long history of settlement and pronounced influences of human activity, in Europe one can only speak of 'wild areas' according to the definition of the Wild Europe Initiative (WEI) when they are intended for designation as wilderness development areas (Job/Woltering/Warner et al. 2016: 486 et seq.). The WEI defines wilderness as 'an area governed by natural processes. It is composed of native habitats and species, and large enough for the effective ecological functioning of natural processes. It is unmodified or only slightly modified and without intrusive or extractive human activity, settlements, infrastructure or visual disturbance' (*BfN* 2017: n.p.). What is important is specific standards for recognising, for example, forests with natural development as wilderness development areas (Job/Woltering/Warner et al. 2016: 486 et seq.).

The 'effective mesh size' (m_{eff}) method developed by Jochen Jaeger is a different approach, which focuses primarily on landscape fragmentation. This method calculates the probability that two arbitrarily positioned points in an area are not separated by an item of infrastructure (such as a road or a settlement) or can still be situated in the same sub-area after fragmentation of the area. Landscape fragmentation thus describes a rupturing of established ecological relationships between physically separate parts of the landscape (Jaeger/Esswein/Schwarz-von Raumer et al. 2001: 306). The more fragmented the landscape, the greater the probability that two points will be separated (fragmentation) and the smaller the mesh size is as a result. Thus the mesh size also specifies the probability that, after a fragmentation due to infrastructure, two animals living in the same habitat will encounter each other again and thus be able to reproduce; m_{eff} is therefore also an indicator of biodiversity. Jaeger/Esswein/Schwarz-von Raumer (2006) also find this indicator useful with regard to recreation. This method of analysis is suitable for research areas of varying sizes with different infrastructures. As an alternative, the degree of landscape fragmentation can also be described using the mesh density, i.e. the effective number of mesh intervals per 100 km² (Jaeger/Esswein/Schwarz-von Raumer 2006: 1 et seq.; EEA 2011: 20 et seq.; *LUBW* [Baden-Württemberg State Institute for Environment, Measurements and Nature Conservation] 2016: n.p.)

'Remote areas' are defined as 'all adjoining parts of valleys […] that are larger than 3 km² (300 ha) and can only be reached and traversed with muscle power and are thus not accessible via drivable roads or passenger cable cars' (Boller 2007: 48). This is often the case for side valleys that branch off from a river basin and are not fragmented by any transport infrastructure. It would be important to take electric mountain bikes into account with the indicators in the future. Compared with conventional mountain bikes, this new technology enables significantly higher ranges within the same period, making it possible to penetrate further into otherwise barely accessible areas – even for users who are less physically fit. This could lead to much higher visitor numbers in such areas. For this 'remote areas' approach developed by the Swiss Federal Institute for Forest, Snow and Landscape Research (*Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft, WSL*), 15 indicators are used (e.g. travel time from the city to the starting point of a hike, number of huts and shelters, especially troublesome objects) to model the temporal, visual and socioeconomic dimensions of remote areas. By assigning points (1–5 points), the degree of remoteness of an area can be analysed and assessed (Boller 2007: 49 et seq.; Boller/Hunziker/Krebs 2008: 2 et seq.). As noted by the authors themselves, the study pursues the paradoxical aim of looking into the question of how hiking tourism in remote areas can be promoted given that the main feature of remote areas is that they lack significant tourism infrastructure and demand. The research area in this case encompassed two valleys in southern Switzerland. In addition to a GIS analysis, 230 quantitative interviews with hikers were conducted (Boller/Hunziker/Krebs 2008: 1 et seq.).

The ecological connectivity approach builds on the idea of the Trittstein-Biotope ('stepping-stone' biotopes) of landscape ecology. Ecological networks attempt to combine habitats and human land use and to improve the connection between semi-natural (cultural) landscapes such as existing conservation areas (Scheurer 2016:

85).[8] A prime example is the Natura 2000 network established according to the 92/43/EEC Habitats Directive (cf. Ssymank/Hauke/Rückriem et al. 1998). Its underlying idea is that ecological connectivity results in open spaces for human activities (in the sense of accessibility for recreational purposes) on the one hand and enables the mobility and circulation of flora and fauna between individual habitats (thus safeguarding genetic viability through megapopulations) on the other, though of course the needs of lynx and of people seeking recreation are not the same (Scheurer 2016: 85). Nature conservation and spatial planning (Raumplanung) play the most important role in the realisation of ecological networks (Kohler 2016: 127).

Ecological connectivity is subdivided into a structural and a functional dimension. While structural connectivity deals mainly with the shape, size and location of artefacts in the landscape, functional connectivity focuses on entire areas within which a species or population can move from one habitat to another. Various studies have shown that 30–40% of an overall area is needed to preserve biodiversity; a figure of 40% is considered necessary for the Alps (Scheurer 2016: 85). Since existing conservation areas and nature reserves already cover approximately 25% of the Alpine Convention area, this means another 10–15% of the area is still needed (Bender/Roth/Job 2017; Scheurer 2016: 85).

Actions in the interest of ecological connectivity and its implementation can be inferred from Article 12 of the Alpine Convention's protocol on nature protection and landscape conservation (Hedden-Dunkhorst/Guth 2016: 79). In addition, the establishment of the Ecological Network Platform was agreed at the 9th Alpine Conference in 2006; its aim is to promote the development of a network of conservation areas, with connecting elements, across administrative boundaries throughout the Alps.[9] This platform brings together members of the Alpine Convention and other stakeholders such as non-governmental organisations and scientists (Hedden-Dunkhorst/Guth 2016: 79). ECONNECT, an EU INTERREG IV project, was such a coalition of associations, umbrella groups, scientific institutions and local implementation partners with the aim of improving ecological connectivity in the Alpine region by mapping the most important ecological connectivity factors (Haller 2016: 137). Seven pilot regions were selected to test the approach that had been developed. Each region consisted of a conservation area and its surroundings; most were cross-border (Hedden-Dunkhorst/Guth 2016: 80). The 'continuum suitability index' (CSI) was developed during the project (Affolter/Haller 2011: 11 et seq.; Haller 2016: 137 et seq.) to assess structural connectivity by evaluating positive structural elements and negative barriers and effects. It serves to illustrate where good conditions for an ecological network are present and which areas are still in need of improvement (Haller 2016: 139).

8 This refers to a network of conservation areas within the European Union that has been gradually implemented since 1992 in accordance with the requirements of the Habitats Directive. Its aim is to provide permanent cross-border protection for endangered wild native plant and animal species and their habitats.

9 cf. https://www.alpconv.org/en/home/ (26 July 2021).

2.2 Definition and delineation of 'open space'

Having outlined the existing concepts and approaches, we will now explain our own understanding of the concept of 'open space'. It is a fact that 'the term "open space" has not been clearly and conclusively defined in the community of specialists' (Häpke 2012: 14). Open space and open space conservation were originally regional planning concepts that first emerged during the reorientation of spatial planning (*Raumordnung*) towards environmental policy around 1974 (Ritter 2005: 336). This was triggered by the problem of increasing greenfield land take. Open space was thus an antonym to settlement and replaced the terms that were common up to that point: 'open and green areas' or 'green space' (Ritter 2005: 336; *DRL* [German Council for Land Stewardship] 2006: 7). This is, thus far, a negative definition; it seems more useful to describe the term in a positive sense. Planning protection was intended to focus on specific functions of natural or semi-natural land (Siedentop/Egermann 2009: 1).

In general, open space is understood to refer to all non-built-up areas (*BMVBS/BBR* 2006: i; *ARE* [Swiss Federal Office for Spatial Development]/*BWO* [Swiss Federal Office for Housing] 2014: 4). From a landscape ecology perspective, open space is viewed as that part of the landscape which is not affected by 'built development or linear infrastructure facilities resembling built development' (Baier/Erdmann/Holz et al. 2006: 11). That does not mean such areas are fully unused: they are not wilderness areas (Schmauck 2015: 16). Even wilderness in the Alps is not completely free of exploitation, so in this respect, there is definitely a certain overlap with the wilderness concept (cf. Section 2.1).

Of interest are semi-natural areas in the sense of predominantly (ecologically) sustainable uses (e.g. extensive agricultural areas, forests, moors, rivers and lakes, farm tracks, cycle paths, hiking trails, bridle paths and mountain paths), which are or may also be subject to interactions between natural and/or anthropogenic factors (cultural landscape) (Ritter 2005: 336; *BMVBS/BBR* 2006: i). They thus consist both of wilderness (nature almost untouched by humans) and cultural landscapes that have been subject to minimal transformation (*BMVBS/BBR* 2006: i). Open spaces within settlement structures (e.g. parks and gardens) are not relevant here (cf. Chapter 1).

In summary, the normative definition on which this work is based is as follows: open spaces include areas that are without buildings of any kind, that are not predominantly developed (piecemeal, linear or extensive infrastructure), that are potentially able to support vegetation, that are ideally free from traffic or reserved almost completely for non-motorised transport and are thus 'noise-free'. Non-structural (in the sense of engineered) infrastructure is not present or is very limited.

Excepted construction includes non-disruptive infrastructure such as sacred buildings, summit crosses, fountains, monuments and paths up to 2.5 m wide (e.g. forestry service roads and agricultural tracks). For the latter, the nature of their surface is important: unpaved surfaces are acceptable and sealed surfaces should be avoided. 'Not predominantly developed' ideally means a semi-natural open space completely free of 'disruptive' infrastructure, or at least with only a small proportion of disruptive

infrastructure such that not more than 20% of the space is developed with infrastructure. The characteristic 'noise-free' is more precisely defined by the threshold of 55 dB, which marks the noise level for annoyance.[10] When drawing up boundaries for open spaces, it is especially important to ensure they are accessible so that people can experience them, as non-mechanised recreation is paramount here. At the same time, traditional conservation and, in part, the protection of natural processes are promoted and general acceptance of open spaces is improved.

10 cf. https://www.bafu.admin.ch/bafu/en/home/topics/noise.html (26 July 2021).

3 Research design and methodology

The aim of this analysis is to identify Alpine landscape areas that are undeveloped, semi-natural or little impacted by infrastructural development and safeguard them as Alpine open spaces through long-term planning while also ensuring that they are accessible for local residents and visitors to experience. Beyond this overarching objective, this study pursues the following secondary objectives:

> to identify and inventorise open spaces in the German-speaking Alpine regions, based on either natural subdivisions (landscape units) or on administrative boundaries in the research area;

> to provide a comprehensive definition and conceptual disambiguation with regard to open space conservation in general and to Alpine open spaces in particular;

> to describe and evaluate existing supranational conventions and strategies (Alpine Convention and EUSALP) and established instruments for the preservation of open spaces;

> to synthesise and consolidate the open space analyses cited here using a variety of indicators with the aim of discussing their similarities and differences as a basis for proposing an ideal approach to open space GIS analyses;

> to assess planning activities relating to open spaces – how the various administrative territorial authorities in the research area (German-speaking and Swiss Alps) deal with open spaces and how open spaces can be safeguarded through long-term planning.

To achieve these objectives, this work makes use of a diverse mix of methods. At the forefront is a meta-analysis of established spatial planning processes for the preservation of open spaces (Chapter 5) and of approaches to identifying and preserving open spaces for which no planning has been implemented at present, with a focus on the German-speaking Alpine region (Chapter 6). Where our descriptions and evaluations of the cited approaches are not based on our own empirical work, we undertook comprehensive reviews of the literature. In addition, we consulted various experts (mostly by email or telephone) on factual issues relating to planning regulations and even to the history of tourism (for example, to complete and validate the compilation of failed development projects in the Bavarian Alps). In addition, some of the findings contained in this work are based on participatory observation and, in some cases, on decades of experience on the part of some of the authors in spatial planning in the Alps, for example on advisory boards and with non-governmental organisations such as CIPRA. The specific methodology of the individual open space analyses and the details of the process with respect to the GIS analyses are described in the case studies in Chapter 6 (GIS operations, technical parameters, infrastructure buffers, etc.) and compared synoptically in Section 6.5.

The research area for this work is, as previously mentioned, situated in the German-speaking Alpine region. The analysis thus considers the areas covered by the Alpine

Convention in Germany (the Alpine areas in Bavaria), Austria (the federal states of Salzburg, Tyrol and Vorarlberg), Switzerland (excluding the Central Plateau and the Jura Mountains) and Italy (the autonomous province of Bolzano-South Tyrol). The centre of the eastern Alpine region in Bavaria, western Austria, Graubünden, South Tyrol and Trentino is among the most intensively developed and exploited tourism regions in the Alps (Mayer/Kraus/Job 2011: 34), giving special relevance to the issue of preserving as yet undeveloped Alpine landscape areas and areas that have been little impacted by infrastructural development. Compared with the Romanic and Slavic Alpine regions, there are much greater similarities in culture, language, history, (tourism) spatial structures and spatial planning regulations in the German-speaking Alpine region (Bätzing 2015a: 60 et seq.). An important aspect in this regard is the Germanic tradition of planning, which has its legal roots in Roman law and the Napoleonic Code Civil and is characterised by a federalistic structure and local planning autonomy (Newman/Thornley 1996: 28 et seq., 33 et seq.; Nadin/Stead 2008). These basic similarities should not deceive one into overlooking the fact that there are some significant differences in spatial and sectoral planning law within the research area. For example, Farinós Dasí (2007: 48 et seq.) classifies Austrian and German spatial planning (*Raumordnung*) as comprehensive, integrative spatial planning systems ('comprehensive planning') but also assigns German spatial planning to the 'regional economic' instruments. With regard to international cooperation, it can be said that spatial planning in the Alpine Convention or the European macro-regional strategy for the Alpine region (EUSALP) plays only a very minor and indirect role (Stead 2011). In all federal countries, spatial planning (*Raumplanung*) is organised at the national level with responsibility generally at the sub-national level and strategically exercised through federal state or cantonal instruments (for example with a federal state development programme or a cantonal development plan). In addition, parcel-specific stipulations and decisions about specific building projects are made by local authorities in any event and are subject to local planning autonomy. This institutional fragmentation complicates harmonisation and cooperation in spatial planning (cf. Zäch/Pütz 2014; Pütz/Job 2016).

The objective of creating and politically implementing a planning instrument for open spaces that is consistent throughout the Alpine region would appear illusory for the time being. Every responsible territorial authority would then have to implement such a regionally adapted instrument on its own and in accordance with its spatial planning jurisdiction – if there is sufficient political and social will to do so at all. This work nevertheless proactively aims to present a conceptual and methodological framework for such a project that defines and delimits Alpine open spaces in a substantively comparable fashion and attempts to implement them with self-dependent responsibility in terms of spatial planning or sectoral law.

4 Supranational regulations

Spatial planning regulations at the transnational level in the Alpine region include the Alpine Convention and EUSALP, which are briefly explained and evaluated from a spatial planning perspective below.

4.1 The Alpine Convention

In resolutions by the European Parliament in 1988 and in the 89-point resolution drawn up at the 1st Alpine Conference of environmental ministers in Berchtesgaden in 1989, there are numerous references to Alpine spatial planning (*Raumordnung*) from the time before the Alpine states and the European Community signed the Alpine Convention in Salzburg in 1991 (Haßlacher 2016f: 116). In particular, points 37 and 60 of the Berchtesgaden Resolution are at the root of efforts to safeguard Alpine open spaces through spatial planning within the framework of the Alpine Convention (International Alpine Conference of Ministers for the Environment 1989: 9, 16):

Point 37: Concretisation of the spatial planning principles in supra-local and local cross-sectoral programmes and plans with binding spatial planning objectives such as:

> keeping extensive areas free of large-scale infrastructural development as far as possible;

> establishing extensive protected zones and Alpine quiet areas.

Point 60: Agree[ment] to cooperate in the achievement of these objectives [in the tourism sector], in particular in designating extensive zones in which no development for tourism is permitted, in forgoing further development of glacier areas and especially sensitive ecosystems and landscape elements, and in reducing the impact of winter sport facilities and harmful leisure activities; this includes a ban on leisure activities that are especially damaging to the environment.

Since 2002, the Convention's implementing protocols, the product of sometimes difficult negotiations, have been ratified in full by Germany, Liechtenstein, Austria, France, Slovenia and Italy and in part by Monaco and the European Commission and have been put into effect. Only Switzerland has signed but not ratified the protocols.

Based on this groundwork, regulations for spatial planning in the Alps in general and in particular for the purpose of safeguarding as yet undeveloped open spaces – called 'tranquil areas' or 'quiet areas' and the like in the protocols – can be identified in four protocols (cf. Table 1):

> the protocol relating to spatial planning (*Raumplanung*) and sustainable development,

> the protocol relating to nature protection and landscape conservation,

> the protocol relating to tourism,

> he protocol relating to energy.

Alpine Convention protocols	**Spatial planning (*Raumplanung*) and sustainable development**	**Nature protection and landscape conservation**	**Tourism**	**Energy**
Article	Article 9(4) lit. b	Article 11(3)	Article 10	Article 2(4) and Article 7(3)
Text	'Delimiting of **tranquil areas** and areas in which construction of buildings and infrastructures is restrained or prohibited, as are other damaging activities' in plans and/or programmes for spatial planning and sustainable development	'They shall set aside **areas of** respect and **tranquillity** that ensure giving priority to the wild animal and plant species over other interests...'	'The Contracting Parties undertake, in accordance with their laws and ecological criteria, to establish designated **quiet areas** where no tourist facilities will be developed.'	'The Contracting Parties shall preserve protected areas and their buffer zones, other protected and **quiet zones** as well as areas of unspoilt nature and countryside...' 'They shall also undertake to protect water resources in areas reserved for drinking water, in protected areas and their buffer zones, other protected and **quiet zones** as well as areas of unspoilt nature and countryside.'

Table 1: Selected protocols of the Alpine Convention

Although the text of the final protocols represents the least common denominator for all the contracting parties, the articles include both mandates on the content of spatial development plans and programmes and an obligation to establish Alpine quiet areas. The latter are, according to the protocol on spatial planning and sustainable development, to be designated by spatial planners in their plans and programmes. In the tourism protocol, the contracting parties are even bindingly called upon to designate Alpine quiet areas; in the protocol on nature protection and landscape conservation, the signatories undertake to promote their designation. Two paragraphs in the energy protocol are in part dedicated to the preservation of Alpine quiet areas (cf. Neger 2016).

Since the protocols took effect, very little interest in an in-depth engagement with their content has been shown by the contracting parties, observer organisations, the Alpine Network of Protected Areas (ALPARC) and the territorial authorities. National agencies are usually not responsible due to jurisdictional considerations. Many territorial authorities also avoid engaging with the matter because of heavy pressure from the business and tourism sectors and because of significant political lack of interest given the prevailing rather neoliberal zeitgeist. Spatial planning (*Raumordnung*) and nature conservation are among the few powers remaining for the regions, and they do not want to lose them.

In addition, the concept of Alpine quiet areas which is anchored in the protocols remains in abeyance in a 'black box' awaiting further discussion (Haßlacher 1992). Since the protocols went into effect and the Permanent Secretariat of the Alpine Convention was established in Innsbruck with a branch office in Bolzano, the issues of Alpine quiet areas and safeguarding as yet undeveloped open spaces have not been taken up either by a working group or in an Alpine Convention platform with the aim of establishing a new 'Alpine spatial planning architecture' (Haßlacher 2017: 98). For this reason, the demands made in an appeal by the German, Austrian and South Tyrolean representatives of CIPRA at the 14th Alpine Conference in 2016 in Grassau, Germany remain relevant. They represent a desideratum of spatial planning political consultants and a deficit in spatial planning policy implementation in many areas in the Alps.

The Alpine Convention is a corrective for the strains placed on the Alpine region. Above all, it is an instrument intended for use throughout the Alps. Aspects of transalpine traffic and, for example, the intense competition among the regions with growing technical infrastructure and ever greater superlatives in summer and especially winter tourism need to be the subject of multilateral discussions at the level of the contracting parties and the regions. Given the increasingly strong competition among the regions, effective limits at the level of isolated regions cannot be achieved on a lasting basis.

Any engagement with the Alpine Convention is important and is a welcome contribution to all aspects of the future development of the Alpine region. Thus far, there has been insufficient engagement with the protocol on spatial planning and sustainable development, and especially with its implementation. The activities required for the implementation of highly complex transnational agreements do not take place on their own; they need to be planned, orchestrated, discussed and set in a legal framework. This protocol is a political programme and contains more than restrictive obligations and binding requirements. To virtually ignore it because spatial planning is not a particularly high priority at present and because there is no lobby seems neglectful (Haßlacher 2017: 98). An initiative by the Alpine Convention's committees to engage with the spatial planning protocol would do the Convention good. To address the precious treasure of undeveloped Alpine open spaces and its safeguarding through spatial planning would be a welcome move.

4.2 EUSALP

With the Alpine Convention addressing the core region of the Alpine arc, the European Commission began in 2000 to increasingly express the desire that macro-regional strategies and transnational cooperation not be limited to just the actual core area of the Alps (the area relevant for the Alpine Convention) but that other major regions in Europe should also be urged towards cross-border cooperation. The idea of the transnational integration of various regions in Europe was met with great interest across the board and led at least to plans for 18 potential macro-regions. Four macro-regions became a reality between 2009 and 2017.

The European Commission would like a macro-regional strategy to develop specific solutions for problems and challenges in peripheral areas as well as urban centres. It thus defines a macro-region as 'an area covering a number of administrative regions but with sufficient issues in common to justify a single strategic approach' (European Commission 2009: 1). Put simply, a macro-regional strategy is based on the idea of fostering better cooperation and coordination in order to deal with cross-border challenges in certain areas more efficiently and effectively than would be possible with individual measures (Permanent Secretariat of the Alpine Convention 2013: 4).

4.2.1 The discrepancy between the Alpine Convention and EUSALP

After a political declaration (the Grenoble Resolution of 2013) by all Alpine states and regions in favour of a macro-regional strategy for the Alpine region was adopted in Grenoble on 18 October 2013, the European Council charged the European Commission with developing an EU strategy for the Alpine region with the aim of improving and strengthening cooperation across and integration of the Alpine core region and the Alpine foreland with its economically powerful metropolises in the long term.

The extremely ambitious project for an Alpine macro-region (EUSALP) was ultimately launched on 19 December 2013. It was clear from the outset that this strategy could not be drawn up and implemented from one day to the next due to the significant differences in the interests of the individual (Alpine) states involved, the participating regions, and the populous and economically powerful metropolitan regions in the Alpine foreland. This was also reflected in the unbalanced ratio of the land areas involved: 190,000 km² for the Alpine region (as defined in the Alpine Convention) and 490,000 km² for the Alpine macro-region. The population difference is even more dramatic: the core region of the Alps has almost 14 million inhabitants, but there are nearly 80 million in a broadly defined geographical area covered by the strategy for the Alpine region and extending to Baden-Württemberg in the north and Lombardy in the south – far beyond the Alpine arc. The danger that the core region of the Alps, with its specific interests, challenges and small-scale structure, might serve merely as an appendage of the business- and growth-oriented EUSALP in the medium or long term should not be dismissed out of hand (Bätzing 2014: 26; Bätzing 2015a: 368 et seq.).

4.2.2 The aims of EUSALP

The basic objective of a macro-regional strategy for the Alpine region involves ensuring sustainable development of the region's sensitive living, working, nature and recreation areas while also respecting the limits of the ecological, economic and demographic burdens imposed on it and relying on innovation and sustainable economic development in line with the precautionary principle (Essl/Beringer/Schabhüttl et al. 2014: 8). For EUSALP, the prosperity of the Alpine region is to be promoted through growth and job creation by improving the region's attractiveness, competitiveness and connectivity under the conditions of an intact environment and healthy and balanced ecosystems. To this end, three thematic objectives were defined (European Commission 2016: 45):

> fair access to employment through improvements in a region's regional competitiveness,

> sustained internal and external accessibility,

> a comprehensive environmental framework and renewable and reliable energy solutions for the future.

Though these objectives provide a certain amount of direction, they also leave plenty of scope for interpretation. This is no surprise given that EUSALP has to involve not only the core region of the Alps but also the populous and economically powerful metropolitan regions outside of the Alpine arc. However, this balancing act leads to fears that the substance and stipulations of the Alpine Convention's protocols, which in contrast to EUSALP are not only legally binding but also provide subject-specific policy guidelines for the comprehensive protection and sustainable development of the Alps, will be gradually watered down and might subsequently play only a marginal role due to the frequent lack of political backing in the states, regions, cantons and municipalities. This concern is now also further strengthened by the existing governance structure.

4.2.3 Do spatial planning aspects play a role in EUSALP?

Nine action groups are responsible for the technical and sectoral implementation of EUSALP (cf. Table 2); their various remits are intended to cover the entire macro-region (European Commission 2015: 5 et seq.). When considering the substance of the individual action groups, one notices that the EUSALP philosophy has little in common with the idea of protection but instead adheres to the principle of (sustainable) growth. In addition to the notion of protection so vital for the Alpine region, none of the nine action groups make any mention of comprehensive spatial planning (*Raumordnung*), the conservation of Alpine open spaces or lasting safeguards for as yet undeveloped landscape areas and units. But these planning instruments are vital for the core region of the Alps as the various (usage) interests (e.g. conservation, environmental protection, tourism, (mountain) farming, transport and settlement infrastructure, commerce and industry) play out in a very limited space. This is also

directly related to emigration from many Alpine valleys and remote regions to the metropolitan areas and could count as one of the greatest challenges in the Alpine region in the coming decades (Essl 2013: 3). Conflicting uses are not limited to the valleys; they often can be found in the mountains as well. Alpine spatial planning ought to be an active component of the EUSALP process for the advancing development of tourism infrastructure in as yet undeveloped landscape areas and units and could thus trigger a new discussion about a spatial planning strategy for the entire Alpine region (Essl 2014: 4). There are currently no spatial planning aspects of significance for the core region of the Alps in the action groups. The greatest benefit could be achieved by assigning them to Action Group 6 and/or Action Group 7 and discussing them subsequently.

Action Group 6	**Action Group 7**
The environment in the Alpine region is extremely sensitive to the consequences of climate change. Its resources must be used appropriately. This action has two main objectives: > to strengthen the Alpine region's natural and cultural resources as an advantage for a high-quality living space; > to ensure the efficient use of existing natural and cultural resources.	'The integrity and functioning of ecosystems, including the conservation of biodiversity and provision of ecosystem services, largely depend on the existence of effective ecological connectivity. There is currently very little promotion of ecological corridors and green infrastructure, including in unprotected areas' (European Commission 2015: 7).

Table 2: Focal points of Action Groups 6 and 7

5 Established instruments for the preservation of open spaces

This chapter presents two instruments for the preservation of open spaces that have become established in spatial planning in the Alpine states, though we have somewhat limited the scope of the discussion in Section 5.1 on the Bavarian Alpine Plan and Section 5.2 on the Tyrolean quiet areas due to the abundance of publications on these topics. Of course, there are more approaches to the conservation of open spaces than the traditional ones mentioned in the following discussion, e.g. conservation areas. However, discussion of these would exceed the scope of this work, especially as they are not (primarily) instruments of spatial planning (*Raumordnung*) but rather sectoral planning instruments for nature conservation.

5.1 Alpine Plan in Bavaria (Germany)

The Alpine Plan[12] is a key element of the Bavarian State Development Programme *(Landesentwicklungsprogramm, LEP)* and has regulated (transport) infrastructure development relating to roads, cable cars, ski lifts, ski runs, airports, etc. in the Bavarian Alps since 1972 through the advance evaluation of projects from a federal state spatial planning perspective. Its aim is to prevent the overexploitation of nature and landscape and to reduce the risk of natural hazards (Hensel 1987: 270; Goppel 2003: 123).

The idea and realisation of the Alpine Plan[13] were the result of a fortunate combination of individual initiatives, lobbying by conservation and mountain sport associations, and political expediency in the early 1970s. In the 1950s, and especially in the 1960s, the Bavarian Alps witnessed an unexpected 'ski boom' in the development of cable cars and ski lifts, which from the mid-1960s was harshly criticised as uncontrolled development by environmentalists and groups representing the interests of hikers and climbers such as the German Alpine Club. In their view, nearly every significant mountain in the Bavarian Alps seemed endangered by its own development project, as if the interests of outdoor (local) recreation were being completely overrun by ski region developers. There were fears that even the most exposed and ecologically sensitive parts of the range would be developed[14] (cf. Karl 1968). In the second half of the 1960s, Dr. Helmut Karl (1927–2009) of the Bavarian conservation agency, the *Landesstelle für Naturschutz*, drew up a zoning plan for the Bavarian Alps based on

12 The term 'Alpine Plan' as such is inaccurate and misleading, because the Alpine recreation area subprogramme of the Federal State Development Programme *(Teilprogramm 'Erholungsraum Alpen' des Landesentwicklungsprogramms)* and the programme's subsection on the Alps as recreational landscape *(Teilabschnitt Erholungslandschaft Alpen des Bayerischen Landesentwicklungsprogramms)* – as they are officially called – do not form a comprehensive plan for the development of the Bavarian Alps but merely regulate the development of transport infrastructure (oral statement by Prof. Dr. Karl Ruppert 2012). However, the term 'Alpine Plan' has become established in general use, which is why it is used here.

13 For details on the Alpine Plan's origins and background, cf. Speer (2008), Goppel (2012) and Job/Fröhlich/Geiger et al. (2013).

14 An example of the arguments in the debate at the time was the premise that the Bavarian Alps were twice as heavily developed with mechanical lifts as the Swiss and Austrian Alps: 'today [there are] a total of 58 cable cars [...]. In Switzerland, in mountains with the same area as those in Germany (4,300 km²), there are 43 cable cars, and in Austria only 21. So by comparison, Bavaria has nearly just as many [sic!] cable cars as Switzerland and Austria combined!' (Karl 1968: 148).

his own cartographic fieldwork and aerial photography; it distinguished three zones according to their ecological importance and degree of existing development. Realising that it would be impossible to keep the Bavarian Alps free of large-scale (tourism) infrastructure on the basis of decisions related to individual cases, Karl initially published his spatial planning strategy for the entire region in 1968 (Karl 1968; cf. Karl 1969; Speer 2008: 284). His decision to make the issue public was triggered by another spectacular development project. In 1967, plans were revealed for the construction of a cable car on the Watzmann (2,714 m, Germany's third-highest mountain) near Berchtesgaden to provide access to a new ski resort, although the Watzmann is part of a nature reserve that has existed since 1921 (cf. Berger 1968).

The Alpine Plan became part of the Bavarian State Government's political agenda for the following reasons: not only were the 1960s and early 1970s characterised by a strong can-do attitude towards technology and infrastructure development, they were also the high point of enthusiasm for technocratic planning. Only against this backdrop was the Alpine Plan's comprehensive and large-scale approach even conceivable. During this era, Bavaria was in 1970 one of the first European regions to allocate responsibility for the coordination of environmental protection and spatial planning (*Raumplanung*) to an independent ministry, the State Ministry for Regional Development and Environmental Affairs (*Staatsministerium für Landesentwicklung und Umweltfragen*) (cf. Barker 1982). By adroitly exploiting these tendencies, Karl and his associates were able to convince the new Minister for Regional Development and Environmental Affairs, Max Streibl, of the idea for the Alpine Plan and the zoning plan that had already been drawn up. Streibl also appears to have recognised the opportunity to quickly raise the profile of his newly established ministry (Speer 2008: 285).

On 1 September 1972, the Alpine Plan went into effect early as a subsection of the Bavarian State Development Programme entitled *'Erholungslandschaft Alpen'* ('Alpine recreational landscape' – four years before the complete Federal State Development Programme in June 1976; the Alpine Plan has remained an integral component of the programme ever since (cf. *StMLU* [Bavarian Ministry of Federal State Development and Environmental Affairs] 1971; Goppel 2003: 123 et seq.; *StMWIVT* [Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology] 2006a; Speer 2008: 285). As part of the Federal State Development Programme (*StMFLH* [Bavarian State Ministry of Finance and Regional Identity] 2013: 2.3 and Annex 3), the Alpine Plan comprises principle 2.3.3 and the zoning for the Alpine region in objectives 2.3.4 through 2.3.6,hence it activates the binding effect of spatial planning requirements in accordance with Article 3(1) of the Bavarian State Spatial Planning Act *(Bayerisches Landesplanungsgesetz, BayLplG)* of 25 June 2012, according to which public bodies must take the objectives of spatial planning into account in spatially relevant plans and measures. The Alpine Plan is thus binding for all public planning agencies such as municipalities and approval authorities (cf. *StMFLH* 2013 for the current map of the Alpine Plan in the 2013 Federal State Development Programme).

The Alpine Plan's primary concern is to balance the various demands on land use in the Alps (e.g. ecosystem services and places where the local population can live and work) with recreation services and the requirements of the tourism sector while protecting large areas of ecologically valuable Alpine open space. This is aimed in particular at enabling 'recreation in open spaces' and in general at ensuring sustainable spatial development in the Bavarian Alps and preventing unbridled development (cf. *StMWIVT* 2006a).

The Alpine Plan is based on the idea that decisions on the permissibility of transport infrastructure development projects play a key role in general spatial development due to their indirect effect on settlement and tourism development. Without easy accessibility (roads, cable cars), tourism in semi-natural areas tends towards a very low intensity level as new development projects are directed to areas that are already more or less accessible. Areas that are as yet undeveloped or only slightly developed are thus kept free of infrastructure development, especially if they are ecologically valuable (Hensel 1987: 270; Goppel 2003: 123). In this regard, the Alpine Plan creates a comprehensive solution that does not depend on decisions related to individual cases; rather the land-use demands are weighed up for the entire Bavarian Alpine region. These intentions behind the Alpine Plan were implemented with a central instrument, the zoning of the whole of the Bavarian Alps (4,393.3 km², excluding lakes; cf. *StMWIVT* 2006b) according to existing land use, ecological sensitivity and future development prospects. The Bavarian Alps were divided by institutional regulation into three zones using these criteria. Each zone represents a territory for different primary functions and options for the future development of transport facilities, tourist accommodation and settlement expansion (Barnick 1980: 4; Barker 1982: 282; Gräf 1982: 268; Grötzbach 1985: 152; Hensel 1987: 270; Goppel 2003: 123; Wessely/Güthler 2004: 52 et seq.; *StMWIVT* 2006a; Speer 2008: 283 et seq., 286):

> Zone A, the infrastructure development zone *(Erschließungszone)* (1,548.3 km²; 35.24% of the Bavarian Alps as delimited in the Alpine Plan), includes all settlements and most areas with existing intensive land uses, e.g. valley areas and tourism locations, and is generally viewed as suitable for further infrastructure development (e.g. with ski lifts), with the exception of airports. Zone A provides areas for ski tourism and other mass tourism recreational activities. Even in Zone A, however, approval is required for every transport infrastructure development measure, and the objectives and principles of spatial planning in the Federal State Development Programme and the regional plans must be observed or taken into account. Otherwise, recreational facilities are in principle unproblematic in terms of federal state planning as long as they do not cause erosion and/or endanger agriculture and forestry.

> Zone B (976.6 km²; 22.23%) serves as a buffer zone in which projects are only permitted after a detailed review and if they do not conflict with stricter regional planning requirements. Infrastructure projects require an individual assessment of their potential environmental impacts and are usually permitted if they are viewed as necessary for agriculture and forestry.

> Zone C, known as the Alpine quiet area (1,868.4 km²; 42.53%), is conceived as a protected zone in which all transport projects, with the exception of measures necessary for traditional agriculture and forestry, are explicitly prohibited and thus implicitly only non-intensive recreational activities adapted to the landscape and close to nature, such as hiking, cycling and cross-country skiing, are permitted. Zone C is generally not suitable for any sort of infrastructural development. The only exceptions are measures for tending to traditional cultural landscapes such as service roads for forestry and seasonal pasturing. At the time of implementation, these exceptions were necessary in order to overcome resistance to the Alpine Plan on the part of the primary sector and the water management agencies (mainly on account of flood protection, the removal of logjams and thus the regulation of watercourses). Zone C mainly covers high mountain areas, conservation areas, almost all of the southern ridges bordering Austria, and the areas at high risk of erosion and avalanches.

With Zone C, the Alpine Plan has, with great foresight since 1972, also been fulfilling the framework convention of the Alpine Convention (Article 2(2) lit. i) that took effect in Germany on 6 March 1995 and the Alpine Convention implementation protocols that took effect in Germany on 18 December 2002 (Spatial planning and sustainable development (Article 9(4) lit. b), Nature protection and landscape conservation (Article 11(3)), Tourism (Article 10) and Energy (Article 2(4))) with regard to the binding establishment of Alpine quiet areas in the areas covered by the Alpine Convention.[15]

Since the initial formulation of the Federal State Development Programme in 1976, the Alpine Plan has been the spatial planning instrument with the greatest continuity; it also remained unchanged during the reform in 2013. This is astounding on the one hand since the Federal State Development Programme otherwise now bears rather neoliberal hallmarks, and on the other hand because the Alpine Plan embodies a spatial planning objective that strictly observes the principle of priority and thus there is no discretionary scope for deviations from spatial planning requirements at the land parcel level (cf. Job/Fröhlich/Geiger et al. 2013).

15 cf. https://www.alpconv.org/en/home/convention/state-of-ratifications/ (26 July 2021); https://www.alpconv.org/en/home/convention/protocols-declarations/ (26 July 2021).

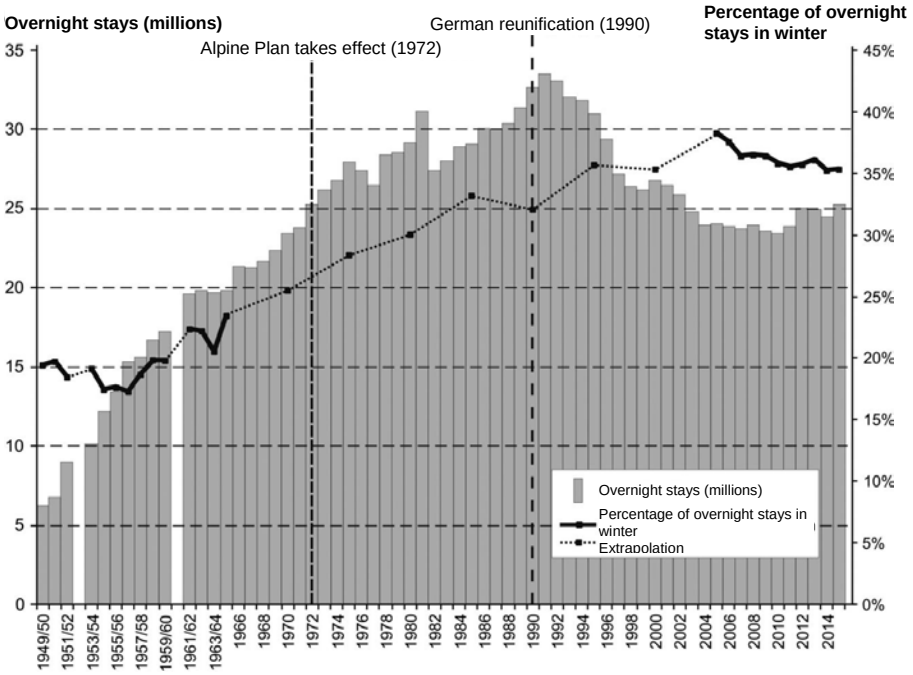

Fig. 1: Overnight stays in the Bavarian Alps between 1949 and 2015 / Source: Mayer/Strubelt/Kraus et al. (2016: 190). The totals for 1981 through 1992 are based on extrapolations derived from overnight stays in commercial lodging establishments (more than eight beds).

In recent years comprehensive scientific evaluations (Job/Fröhlich/Geiger et al. 2013; Job/Mayer/Kraus 2014; Mayer/Strubelt/Kraus et al. 2016) have confirmed the effectiveness of the Alpine Plan for protecting the Bavarian Alps from overdevelopment without negatively influencing tourism trends (cf. Fig. 1). Indeed, strengthening the system of protected areas has ensured that there will be opportunities for recreational activities in semi-natural environments in the long term. However, the increasingly individualised nature of recreational sport in the Bavarian Alps (e.g. crosscountry skiing, snowshoeing, riding electric mountain bikes) cannot be controlled by spatial planning approaches like the Alpine Plan.

Zone C's powerful steering effect as a spatial planning standard for preventing development and thus avoiding land use conflicts can be clearly seen in Figure 2. Figure 2 and Table 3 provide an initial overview of the unrealised development projects for ski tourism in the Bavarian Alps, underscoring the Alpine Plan's protective function for open space.

Nineteen intended but as of today unrealised projects have been identified, of which only three are still currently being pushed by their backers (the most prominent of these is the Riedberger Horn project mentioned in Chapter 1). A comparison with 46 ski resorts currently in operation in the Bavarian Alps (Mayer/Steiger 2013: 179, revised) illustrates the quantitative aspect of development plans that were prevented,

with the Alpine Plan playing a key role in most cases. Without the Alpine Plan, the Bavarian Alps would be much more intensively developed than they are now and, given the doubtful profitability of many cable car operators and ski resorts (11 of the 57 ski resorts in the Bavarian Alps have already closed; cf. Fig. 3; cf. Mayer/Steiger 2013: 179, revised), the competition for passengers would be even stiffer today and the probability of failed and environmentally destructive investments significantly higher. Twelve of these projects involve as yet undeveloped mountain peaks (Riedberger Horn, Stuiben in the Naglefluh range, Alpspitze, Hirschberg, Brecherspitze, Stolzenberg, Rotwand, Brünnstein, Geigelstein) or even massifs that to this day remain free of mechanical lifts of any kind (Watzmann, Inzeller Kienberg, Hochgern). Seven cases involve expansions or mergers of existing ski resorts (Hochgrat, Schappoltkopf, Koblat, Wetterwandeck, Aiplspitze, Predigtstuhl, Dürrnbachhorn) that were prevented. Such prevention of development could not have been achieved within the legal framework of Bavaria's Nature Conservation Act (*Bayerisches Naturschutzgesetz, BayNatSchG*); of the 19 projects planned for development since the implementation of the Alpine Plan in 1972 and depicted in Figure 2, only six summits enjoy similarly strict protection – as nature reserves. However, only two of those locations (Inzeller Kienberg, Dürrnbachhorn/Sonntagshorn) were granted this legal protection before 1972 (both in 1954). The other 13 cases are designated as landscape conservation areas, which enjoy a much lower degree of protection, or have not yet been placed under protection (Predigtstuhl, Hochgern).

The limited effectiveness of landscape conservation areas against the construction of cable cars is highlighted in Figure 3, which shows that numerous ski resorts in the Bavarian Alps are in landscape conservation areas. The biosphere reserve near Berchtesgaden and the Nagelfluhkette nature park, both of which were established well after the installation of tourism infrastructure, also have no preventive effect in this regard. Figure 3 thus emphasises the steering effect of Zone C, which has limited the ski resorts to Zones A and B with its additional stricter and, compared with most other categories of conservation area, stronger protective role. In addition, it reveals a significant concentration of ski resorts in the northwestern Oberallgäu region; competition among these neighbouring resorts is certain to be further exacerbated by the planned merger of the Grasgehren and Riedberger Horn (Balderschwang) areas.

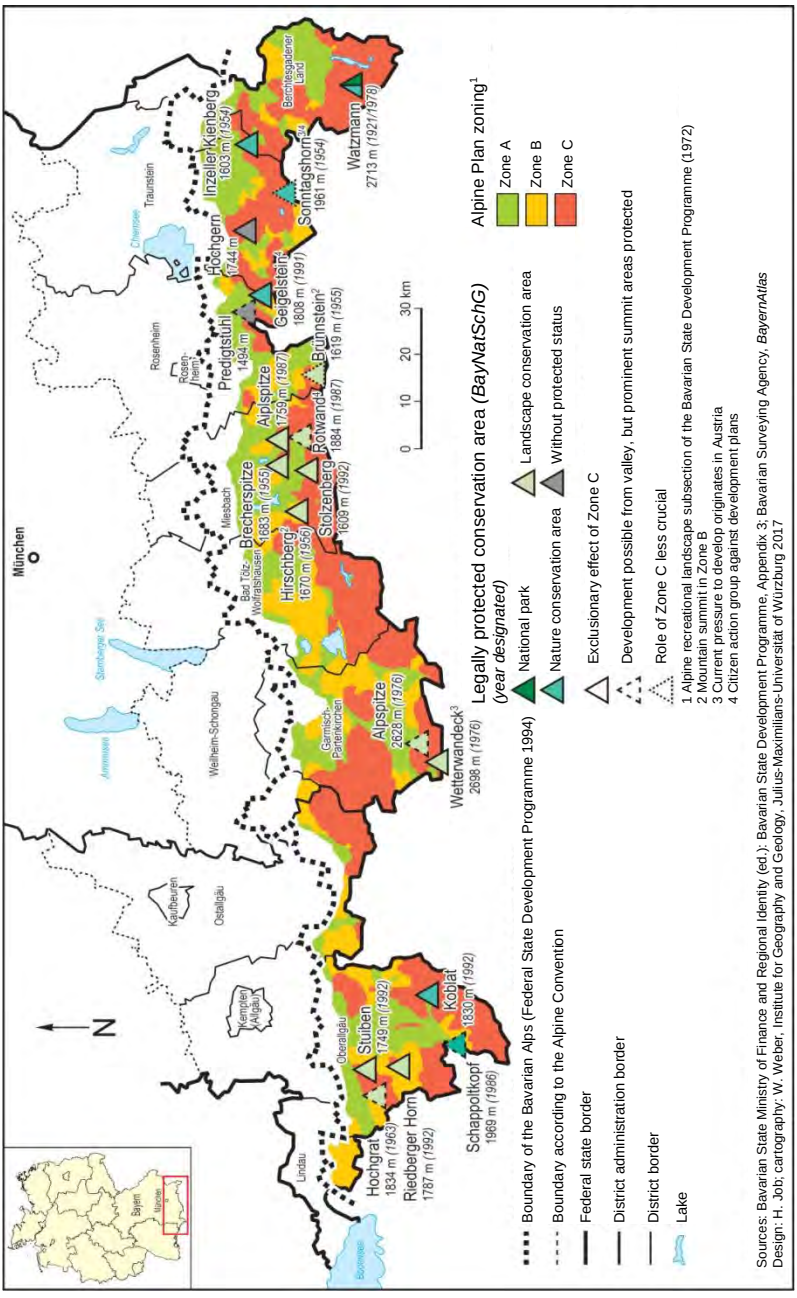

Fig. 2: Mountain summits in the Bavarian Alps with planned but unrealised development projects for ski tourism (Alpine Plan region as of 1 January 2017)

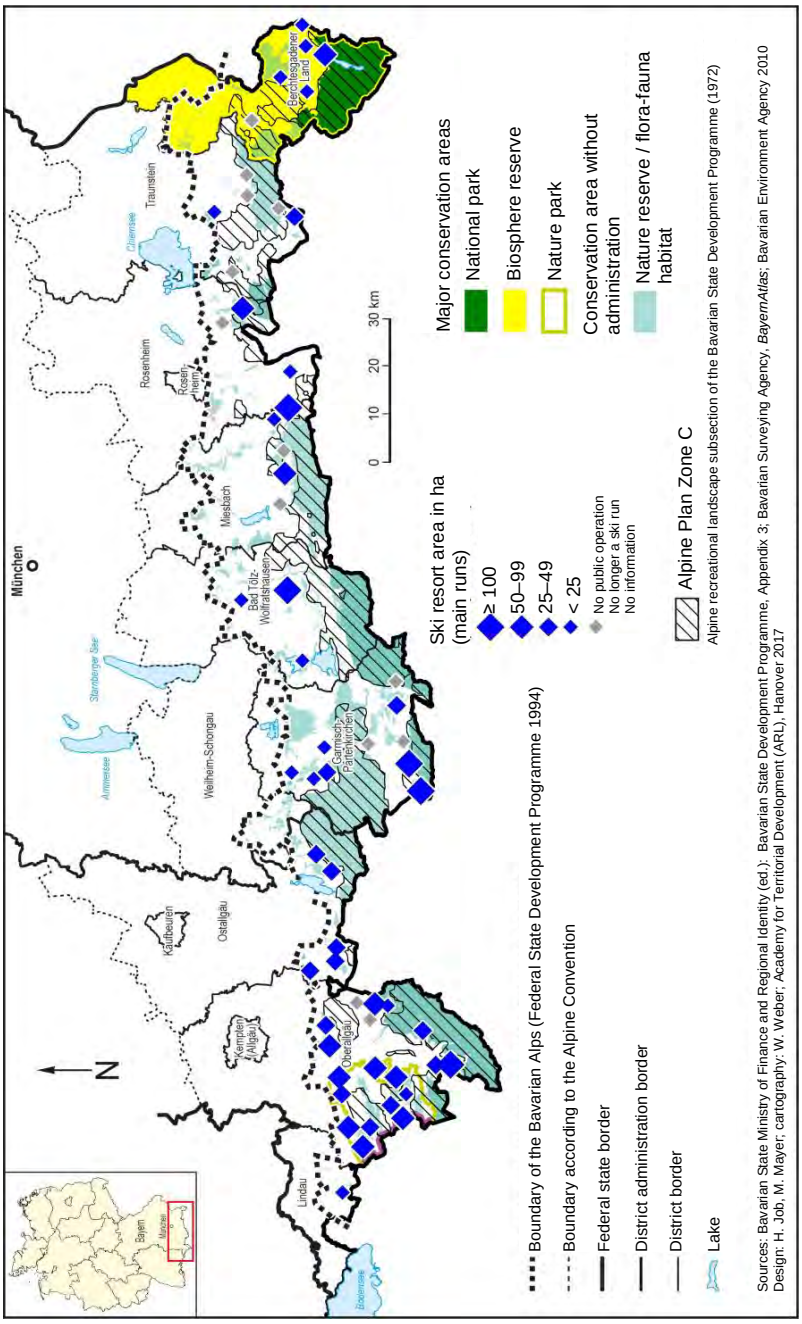

Fig. 3: Conservation areas and ski resorts in the Bavarian Alps

Project	**Planning history and intended infrastructure**	**Non-realisation** (as of 1 January 2017)
Hochgrat (near Oberstaufen)	Summit hotel planned in 1959 with feeder cable car from Oberstaufen; construction of 4-person monocable gondola lift to mountain shoulder in 1973.	Zone C was deliberately drawn along the edge of the upper station so that connections into the Nagelfluhkette landscape conservation area would be prevented.
Riedberger Horn (near Obermaiselstein)*	Grasgehren ski resort since 1967; similar applications for expansion in 2008, 2011 and 2014; intention: to connect ski slopes and cable car to Balderschwang.	Zone C; large intact population of black grouse (de facto bird sanctuary under EU law); very unstable slopes.
Stuiben (near Immenstadt)	Planned connection to Immenstadt; specifics unknown.	Zone C
Schappoltkopf (near Oberstdorf)	Intended connection to the Schlappoltalpe (Alpine Plan Zone B); no further details.	Zone C between Fellhorn summit and Schlappoltkopf mountain and lake did not interfere with connection to Fellhorn.
Koblat (near Hinterstein, part of Bad Hindelang)	Connection from Nebelhorn planned in the early 1980s. In 1996: new Koblat 4-person chairlift built on Nebelhorn; new plans for ski run and lift into Obertal over the Wengenalpe and the Giebelhaus hut into the Hintersteiner Valley.	Alpine Plan Zone C; nature reserve status.
Wetterwandeck (near Garmisch-Partenkirchen)*	Initial plans for a valley run from the Zugspitzplatt to Austria in the 1980s, 2009 and most recently in 2011: 790 m tunnel from Wetterwandeck to Ehrwalder Alm ski resort; gondola lift from there to the Wetterwandeck; several new ski runs planned.	Zone C; extremely high capital expenditures and operating costs.
Alpspitze (near Garmisch-Partenkirchen)	Plans for construction of large gondola lift to the Alpspitzschulter (2,260 m) became public in autumn 1962; it was built only as far as Osterfelder Kopf (Zone B) in 1973; connection to Grieskar and Stuibenkopf planned.	Zone C, alternate routes in Osterfeld area.
Hirschberg (near Kreuth)	1965: plans for large or small gondola lift from the Point area in Kreuth to the summit. Mentioned again in 1970. Situated in Zone B.	Today: small ski run with two surface lifts on the lower slopes.
Stolzenberg (near Spitzingsee)	Specific plans in 1970 for extension of Stümpfling-Sutten ski resort at Spitzingsee; gondola lift from near the Albert Link hut to slightly short of the summit.	Likely not prevented by the Alpine Plan as the north slope intended for development is in Zone A.

Brecherspitze (near Schliersee)	Surface lift to southwest ridge in 1967 (Zone B); plans to connect the north flank in 1970 with two gondola lift segments, two surface lifts, connection to existing ski resort.	Zone C; expansion for mass tourism would have been very expensive.
Aiplspitze (near Bayrischzell)	Specific plans in 1966: several surface lifts totalling around two kilometres in length from Geitau through the Alpbachtal valley to shortly below the Aiplspitze near the abandoned Alpine pasturing facilities.	Zone C
Rotwand (near Schliersee-Bayrischzell)	Development planned for Rotwand in 1963 was not realised. Plans in the 1970s and 1980s involved a cable car and 10 surface lifts over the Rotwand to connect the Spitzingsee and Sudelfeld ski resorts over the town of Bayrischzell.	Zone C; involvement by local action group (multiple efforts for designation as a nature reserve since 1971 have been fruitless); alternate connection to Taubenstein with 4-person monocable gondola lift in 1971.
Brünnstein (near Oberaudorf)	Concrete plans in 1967 called for gondola lift from Buchau to western summit; four ski lifts were planned for the northern slopes of the massif; upper station with tunnel to planned mountain hotel on south side of summit; a connection to Sudelfeld was envisaged.	Easier access to nearby Tyrolean ski resorts by extending transport routes; summit in Zone B.
Predigtstuhl (near Aschau)	Gondola lift to Hochries in 1973; failed plans for hotel and further chairlifts and surface lifts over the Laubenstein cirque, Abergalm on the Predigtstuhl and Trockenbach Valley.	Zone C; unprofitable railway.
Geigelstein (near Sachrang)	Repeated discussions from the 1970s to the 1990s about mechanical lifts from the now-closed Schleching ski resort towards the summit; plans for small gondola lift from Sachrang to the southwest flank (Zone B) on the Geigelstein (borders on Zone C). In 1978, Germany's Federal Border Guards (Bundesgrenzschutz) planned a high-performance ski training facility on the Schachenberg (Zone B) west of the Geigelstein.	Zone C and Zone B; many years of controversy surrounding the establishment of the Geigelstein nature reserve, whose designation was prevented in 1991 by the plans for the cable car (Zone A/B areas); citizen action group since 1974.
Hochgern (near Marquartsein)	Nothing specific known, mentioned by Dr. H. Karl in Speer (2008).	Zone C; decision to develop the neighbouring Hochfelln (which was already under construction at the time).

Dürrnbachhorn (near Reit im Winkl)*	Chairlift to Dürrnbacheck in 1952; plans for expansion since 1973 (including a rack railway up to the Dürrnbachhorn), taken up again in 2013; the intention is a ski connection with the Heutal ski resort in Unken, Austria.	Resolution on mountain forests by the Bavarian State Government in 1984 banned clearing in protected forests, including state-owned forests in Austrian territory; status as nature reserve; Alpine Plan Zone C (summit and north slope) and Zone B (south slope, which is also Austrian territory); local action group against expansion since 1992.
Inzeller Kienberg (near Inzell)	Plans from 1966–1967 called for two segments of gondola lift west of the borough of Schmelz over the northwest slope; four combined surface lifts/chairlifts on the south side; forest clearing for three ski runs over the northwest slope.	Alpine Plan Zone C and status as nature reserve.
Watzmann (near Berchtesgaden)	Initial plans in 1953, last pushed in 1968; gondola lift to the summit house, a hotel there; also plans for connection to Watzmannkar.	Zone C; status as nature reserve; later a national park (1978).

* Project currently active

Table 3: Unrealised development projects for ski tourism in the Bavarian Alps (from west to east, cf. Fig. 2) / Sources: The authors, based on Link 1963, Link 1965, Link 1967, Pause 1967, Seydel 1968, Pause 1970, n. n. 1971, Lintzmeyer/Lintzmeyer 1997, Speer 2008, Sebald 2011, Stankiewitz 2012, Huber 2013, Mang 2014, CIPRA Germany 2015, Kreitmayer 2015, Vögele 2015, Werth/Kraft 2015, Bayerle 2016, Fanderl 2016, n. n. 2016 and oral communications from Prof. Dr. Konrad Goppel (2016), Christoph Himmighoffen (2016), Dr. Reinhold Koch (2016), Dr. Klaus Lintzmeyer (2016) and Henning Werth (2016)

It can also be seen that the taboo effect of Zone C is not always the sole reason for a failure to realise planned ski tourism developments (cf. Table 3). A complex mix of other influencing factors (including the financial situation of the businesses involved; the costs, effort and environmental impact of development; political support at the local level and from approval authorities and the state government; the local and regional competitive environment; the border situation and transport links from Austria; 'trade-off' transactions with realised projects) that can scarcely be sorted out several decades after the fact without extensive historical research is often a contributing factor in the failure to realise the projects. The Brünnstein can be cited as an example of this as its summit area is in the less strictly protected Zone B. Extensive development was planned there in 1967; however, the plans were ultimately abandoned for financial reasons, not least due to the completion shortly afterward of the Inn Valley autobahn and the fast border checkpoint at Kiefersfelden, which made the competing ski resorts in northern Tyrol much more easily accessible. Further examples include the projects at Hirschberg (Zone B), Stolzenberg (Zone A on the north flank where development was planned) and Geigelstein (southwest

flank to Sachrang in Zone B). In addition, the resolution on mountain forests in 1984 and the Alpine Convention, which took effect in 1991, certainly also had an effect.

In conclusion, it can be noted that there has been no exception permit granted for an infrastructure project in Zone C since 1972, thus avoiding lengthy and conflictive debates about individual cases and high costs for administrative planning approval work, and thus preventing numerous infrastructure projects.

5.2 Quiet areas in Tyrol (Austria)

The Tyrolean quiet areas are an important instrument for conserving Alpine open space. They were first developed in 1972/1973 in the Landscape Plan drawn up by the Tyrolean state forestry inspection body *(Tiroler Landesforstinspektion)* for the whole of the Tyrol. In contrast to the Bavarian Alpine Plan (cf. Section 5.1) and the Swiss 'Conservation inventory of landscapes and natural monuments of national importance', produced at much the same time, this landscape plan had no legal effect (Haßlacher 2016b: 7). The proposals for quiet areas made in the Tyrol Landscape Plan were, however, taken up by regional planning. The legal anchoring of the quiet areas was implemented using ordinances in line with a resolution of the federal state government, but only after their inclusion in the Tyrol Nature Conservation Act *(Naturschutzgesetz)* in 1975. The safeguarding of Alpine open spaces through spatial planning is based on the technical foundations provided in the Tyrolean Recreational Space Strategy *(Tiroler Erholungsraumkonzept)*, specifically in the chapters on tourism and Alpine spatial planning (Office of the Tyrolean Government [*Amt der Tiroler Landesregierung*] 1981).

Alpine spatial planning (Raumordnung)

The term 'Alpine spatial planning' was coined in the late 1970s as a reaction, particularly by Austria's Alpine clubs, to plans for glacier ski resorts in Tyrol. Because of rapid growth in tourism due to cable car construction on the one hand and demands that extensive quiet areas be kept free on the other, state planners in Tyrol were often confronted with the question of achieving spatial development that is optimally balanced between protection and exploitation. They were the first to formulate objectives for 'Alpine spatial planning'. The aim is 'to create extensive quiet areas as a counterpart to infrastructure development zones for tourism, i.e. ultimately to divide the Alpine region into areas of intensive ('mass') tourism and quiet areas with only minimal tourism impact' (Barnick 1980: 4; Barnick 1985: 262). Clearly, Alpine spatial planning conceived of in this way will always be only part of an overall area's supra-local spatial planning.

In any event, this represents the starting point for many quiet area ordinances in Tyrol and the consideration of this spatial planning objective in the development programmes for individual planning areas. In the view of Austria's largest non-governmental organisation for conservation, the Austrian Alpine Association (Österreichischer Alpenverein), the consolidation of tourism offerings, strategies for preventing and disrupting the spiralling growth of tourism, establishing final limits to development in the Alps (partly by preserving extensive semi-natural

areas), and the development of alternatives to mechanised tourism counted among the tasks of Alpine spatial planning at the start of the 1990s (Haßlacher 1991: 16). In the preface to a document on the 2005 Tyrolean spatial planning programme for cable cars and ski infrastructure, the responsible minister, Anna Hosp, said: 'The construction of cable cars and ski resorts thus cannot be an exclusively commercial decision. Instead it needs to be viewed in the overall context of sustainable Alpine spatial planning in which all aspects of use and protection are taken into account in a balanced manner' (Office of the Tyrolean Government 2005: 3). Ultimately, the Alpine Convention enriches the discussions about and the application of Alpine spatial planning (cf. Section 4.1). There are plenty of starting points and building blocks for further consolidation of Alpine spatial planning in both the purely political resolution by the environment ministers at the 1st Alpine Conference in Berchtesgaden in 1989 and the four relevant protocols in effect in all Alpine states except Switzerland (Haßlacher 2016f: 117). The safeguarding of Alpine open spaces thus awaits implementation by way of the Alpine Convention, in which spatial planning, conservation, tourism and the energy industry all play important roles.

The tasks of Alpine spatial planning are (Haßlacher 1991: 16):

> working towards the consolidation of tourism offerings, especially in highly developed tourist centres;

> developing strategies to prevent and disrupt the dangerous growth spiral and to automate congestion relief for tourism infrastructure;

> finding alternatives to mechanised tourism;

> working towards the establishment of final limits on development in the tourism, energy and transport sectors and the preservation of extensive semi-natural areas as a counterpoint to the intensively used commercial and tourism regions.

According to the Tyrolean Nature Conservation Act, quiet areas are situated outside built-up areas and are particularly suitable for peaceful recreation and relaxation. They are free from noise-generating enterprises, public passenger transport and public roads. They are characterised in particular by clear bans with no exceptions:

> no establishment of noise-generating enterprises,

> no installation of cable car tracks for public transport and no ski lifts,

> no new roads for public transport,

> no significant noise generation (excluding measures for the energy transition since 2015),

> no off-field landing or take-off of motorised aircraft for tourist purposes (with very isolated exceptions).

Quiet areas can also set limits for the development of engineered infrastructure by directly bordering on the outer boundaries of ski resorts and on roads. Owing to the clear bans they embody, quiet areas are also preferred in the designation of conservation areas when the aim is to set definitive limits to ski resorts (e.g. in Seefeld and Achenkirch with the Eppzirl and Achental-West quiet areas in the Karwendel). Landscape conservation areas cannot achieve this due to their weaker protective status. Quiet areas thus represent a consistent Alpine zoning designation to safeguard undeveloped open spaces, anchored in the sectoral planning of nature conservation. Specific nature conservation management tasks can then be agreed with landowners and local authorities at a later point (Haßlacher 2007b: 88).

Based on the various plans stemming from official regional planning, the Austrian Alpine Association, the environmental protection department of the Office of the Tyrolean Government and the conservation area management bodies, eight quiet areas were approved and designated in Tyrol by the federal state government between 1981 and 2000 (Haßlacher 2016b: 7; Table 4). With a total area of 1,370.94 km², they occupy 10.84% of Tyrol's land area, mostly in Alpine locations.[16] For comparison, the permanently settled area in Tyrol is 11.8% of the total area. The oldest quiet area, Ötztaler Alpen, dates from 1981. The largest by area is the Zillertaler and Tuxer Hauptkamm quiet area first designated in 1991, which was expanded by 42.71 km² to 421.71 km² on the Tuxer Hauptkamm on the occasion of its 25th anniversary.

The legal protection of further undeveloped Alpine spaces in Tyrol is difficult due to the significant influence of the tourism and cable car sectors, so it is assumed in various quarters (journalists; politicians from outside of Tyrol, both in Austria and abroad; large segments of the population) that existing quiet areas are constantly being reduced in size by the expansion of ski resorts, yet that is not the case. Only in 1997 was the Ötztaler Alpen quiet area reduced in area from 397.6 km² to 396 km² (-0.33%) at its extreme eastern edge to connect the ski resorts of Obergurgl and Hochgurgl in the municipality of Sölden. The Zillertaler Hauptkamm quiet area underwent a minor correction that reduced its area from 372 km² to 371.78 km² (-0.06%) due to the removal of a transformer building belonging to a cable car company. There have been no other boundary changes.

Years of efforts by cable car companies and neighbouring municipalities to push various projects through – particularly in the Kalkkögel quiet area that has existed since 1983 – have all failed. According to Article 11(1) of the nature protection and landscape conservation protocol, such projects are contrary to the articles of the Alpine Convention that are directly applicable at the national level (Haßlacher 2011a; Haßlacher 2011b; Essl 2017).

16 The authors' calculations.

In the reform of the Tyrol Nature Conservation Act in 2015, an exception clause was included for significant noise generation caused by projects for the energy transition ('construction noise at levels commensurate with this purpose') in quiet areas. This clause could be crucial to the approval of the expansion project for the Sellrain-Silz/Kühtai hydroelectric plant for activities such as the construction of stream channels in the Stubaier Alpen quiet area.

Now that multiple quiet areas have existed for periods that in some cases extend over several decades, their steering effect on Alpine spatial use can be demonstrated beyond doubt. Eighteen projects for ski tourism development (cable cars) and roads for motor vehicle traffic from the time before the designation of the quiet areas or while the designation has been in place are recorded in planning documents and have been publicly discussed. They were not realised due to the Tyrolean quiet area ordinances (cf. Fig. 4 and Table 4); indeed, after in-depth political and public discussion, they did not even reach the procedural stage due to the clear content of the ordinances. The implementation of each of these projects would have required the complete annulment of a quiet area and a new ordinance by the federal state government following a complex procedure for the submission of statements. Such administrative processes were obviously not about to be launched.

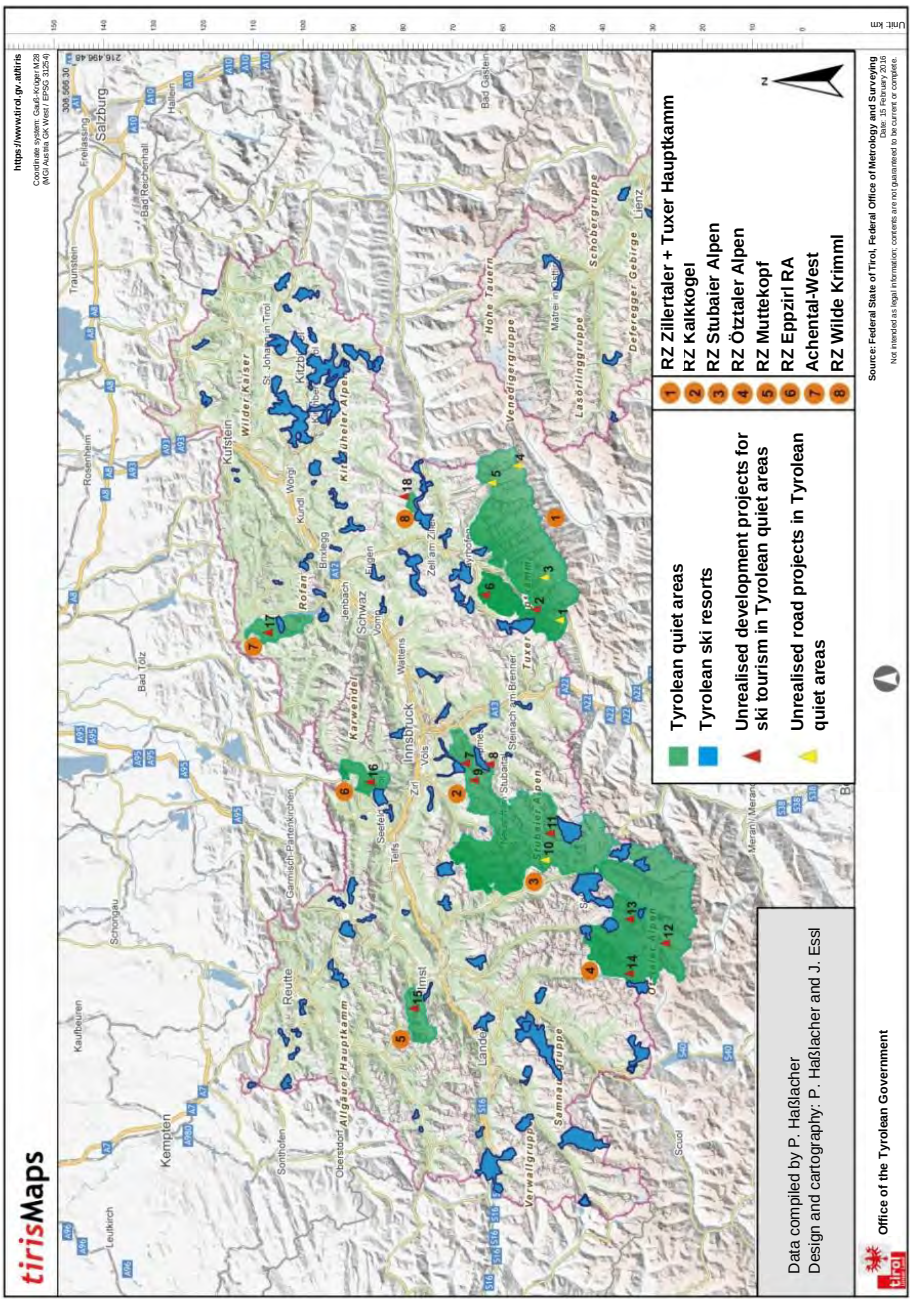

Fig. 4: Unrealised development projects for ski tourism and roads in the Tyrolean quiet areas (RA)

Consec. no.	Quiet area	Date Government resolution	Area (km^2)	Municipalities	Project no.	Development projects	Project announced before initial ordinance	Project announced after initial ordinance	Project is current Yes	Project is current No
1	**Zillertaler und Tuxer Hauptkamm**	2 July 1991 (IO)	372.00	Brandberg, Finkenberg, Mayrhofen, Tux	1	Extension of B169 (Zillertaler Bundesstraße) to Pfitscher Joch (→ through road from Zillertal to Sterzing)	✓			✓
		3 February 1998	371.78							
		2 May 2006	379.00		2	Feeder line from Schlegeis reservoir to Hintertux glacier ski resort	✓			✓
		7 October 2016 (IO)	421.71		3	Zillertaler Hauptkamm tunnel for Alemagna motorway	✓		✓ (in Italy)	✓
					4	Zillertal-Ahrntal ‘friendship road’ over Hundskehljoch	✓			✓
					5	Access to road across dam crest of Zillergründl reservoir for private motor vehicles	✓	✓		✓
					6	Construction for new Kreuzjoch ski resort	✓			✓

2	**Kalkkögel**	26 July 1983 (IO)	77.70	Axams, Götzens, Grinzens, Mutters, Neustift im Stubaital, Seilrain, Telfes	XX 8 9	Connection of Schlick and Axamer Lizum ski resorts via Kalkkögel quiet area Feeder line, Neustift im Stubaital (Neder) to Kaserstattalm and Sennjoch <u>Next steps:</u> Niederer Burgstall, Schlicker-Schartl-Seejöchl; Oberbergtal-Milderaun; (long-term: Stubai glacier ski resort)	✓ ✓ 	 ✓	✓ ✓ ✓	
3	**Stubaier Alpen**	26 July 1983 (IO) 2 May 2006	348.90 352.20	Längenfeld, Neustift im Stubaital, St. Sigmund, Sölden, Umhausen	10 11	Mountain road connecting Stubaital and Ötztal (via Sulztal) from 1960 spatial planning outline Expansion of Hochstubai glacier ski resort into Glamergrube	✓ ✓		 ✓	✓
4	**Ötztaler Alpen**	27 October 1981 (IO) 10 June 1997 2 May 2006	396.00 394.70 405.53	Kaunertal, St. Leonhard im Pitztal, Sölden	12 13 14	Connection of Schnalstal glacier ski resort with Vent Connection of Vent, Rofenkar and Pitztal ski resorts Ski run down Gepatschferner glacier after possible expansion of Kaunertal glacier ski resort to Gepatschferner	✓ ✓	 ✓ 	 	✓ ✓ ✓

5	**Muttekopf**	9 July 1991 (IO)	38.00	Imst, Pfafflar	15	Expansion of Hochimst winter sport area towards Seebrig	✓			✓
6	**Eppzirl**	20 December 1988 (IO)	33.40	Schamitz, Seefeld, Zirl	16	Expansion of Seefeld winter sport area to the Eppzirler Alm area	✓			✓
XX	**Achental-West**	20 December 1988 (IO)	38.10	Achenkirch, Eben am Achensee	17	Expansion of the Christlum winter sport area towards Hochplatte, Kleinzemm and Gröbner Hals	✓			✓
8	**Wilde Krimml**	20 June 2000 (IO)	4.30	Gerlos, Stummerberg	18	Strategic spatial planning limitation of development possibilities towards Torhelm, Katzenkopf, Rifflerkogel	✓			✓
TOTAL AREA			**1,370.94**							

IO = Initial ordinance

Table 4: Quiet area ordinances in Tyrol and prevented development projects / Source: Peter Haßlacher, research by the authors, Tyrolean Law Gazette (Landesgesetzblätter für Tirol)

Special project clusters were located in the upper Zillertal valley in the 1980s and are now in the Kalkkögel area between the western Innsbrucker Mittelgebirge and the Stubaital valley (cf. Fig. 4). Implementation of the road projects in/through the Zillertaler Hauptkamm would have made the Zillertal a north-south transit valley; the so-called Zillergründe, a peaceful retreat in the upper valley, would have been lost to the mass tourism of the middle and lower Zillertal. In contrast to the improved situation in the Zillertal, the Kalkkögel quiet area, the 'Dolomites of North Tyrol', harbours considerable potential for conflicts (Essl 2017). In spite of clear requirements from the Alpine Convention that have repeatedly been scientifically verified, with a changed political situation the controversy could begin anew. An inherent disadvantage of conservation and Alpine spatial planning becomes quite clear: those behind the projects can renew their efforts to push their projects through again and again. Conservation advocates need lose only once, and then the space claimed by a project is lost as well. As Figure 4 shows, some of the smaller quiet areas show the clear prohibition on the construction of additional cable cars.

In Tyrol, only the Eppzirl and Achental-West quiet areas in the Karwendel nature park and the Ötztaler Alpen quiet area are part of the Natura 2000 network. The Zillertaler und Tuxer Hauptkamm, Eppzirl and Achental-West quiet areas and parts of the Stubaier Alpen and Ötztaler Alpen quiet areas have been designated as nature parks. However, the quiet area ordinance remains the legal basis for their protected status.

In addition, according to the 2005 Tyrolean spatial planning programme for cable cars and ski infrastructure, which has been in effect since 1995 (Office of the Tyrolean Government 2005: 5), the expansion of existing ski resorts is not permitted if they would occupy national park land or land in areas designated as protected areas by ordinances on the basis of the Tyrol Nature Conservation Act. The quiet area category is explicitly listed as such a protected area. While the cable car and ski resort programme in Tyrol is reviewed and redefined every five years, the legal substance of the quiet area ordinances with respect to cable cars and roads has not changed since 1975. There has thus far been no majority in Tyrol's parliament for efforts to change the Tyrol Nature Conservation Act with respect to quiet areas.

6 Approaches to the preservation of open spaces without previous spatial planning implementation

Having presented the established instruments for preserving open spaces, we now turn our attention to approaches to protecting them that have not been implemented in previous spatial planning (*Raumplanung*). These include the 'Alpine quiet areas' in the federal state of Salzburg, the 'white zones' in the federal state of Vorarlberg and the 'undeveloped areas' of South Tyrol. In addition, we present our own study of 'semi-natural open spaces' in Switzerland. It should be noted that not all of the researchers who conducted the studies were involved as authors of this publication; this has influenced the choice of areas which are the focus of this paper.

6.1 Alpine quiet areas in the federal state of Salzburg

The stipulations of the Alpine Convention permit the designation of priority zones for Alpine quiet areas. Among the protocols in which this is anchored, and thus in principle obligatory, are those for 'Spatial planning and sustainable development' (Article 9(4) lit. b), 'Tourism and leisure' (Article 10) and 'Nature protection and landscape conservation' (Article 11(3)). Salzburg's 2003 Federal State Development Programme adopted this provision granted by public international law for use as a spatial planning instrument, though it has thus far only been implemented at a regional level (e.g. Tennengau). The laws also include some legal principles for conservation and spatial planning.

For example, the draft amendment of Salzburg's Nature Conservation Act of 3 April 2017 includes the following formulation for section 27(3) on the protection of the landscape and recreation areas: 'In addition, the federal state government can, by ordinance, designate Alpine quiet areas in green spaces in which, in the interest of protecting the environment or special recreation areas, certain sporting, tourism or other activities are banned completely or in certain areas or permitted only under certain conditions, especially if they impair the appearance of the landscape, the landscape's recreational value or the balance of nature.' It has been possible since 1992 to implement Alpine quiet areas through Salzburg's Nature Conservation Act. However, to this day no Alpine quiet area has been designated through nature conservation law in the federal state of Salzburg. Salzburg's spatial planning legislation *(Raumordnungsgesetz)* is also being reformulated (draft amendment dated 21 December 2016). Section 2 (Aims and principles of spatial planning) states: 'Spatial planning shall pursue the following aims: [...] Tourism is to be developed and kept competitive while taking the ecological resilience and economic capacity of a given space into account.'

Elaborating on this spatial planning objective, the draft amendment further states: 'The landscape is the most important capital of a successful tourism industry. However, landscapes outside of permanently settled areas, especially in Alpine regions, are highly vulnerable to uses that are extraneous to their character; tourism can bring such spaces close to the limits of their ecological resilience. For example, in the Alpine pastures, pasture farming that includes serving food and beverages is

still appropriate, but the construction of rural dwellings and other means of overnight accommodation beyond the protective nature of mountain huts must be considered inappropriate. The designation of Alpine quiet areas is intended to prevent overuse through tourism' (Austrian Federal State of Salzburg 2016: 41).

Salzburg's Federal State Development Programme is currently undergoing revision. To that end, an as yet unpublished study was commissioned by the Office of the Federal State Government of Salzburg; its objective is to concretise the aforementioned legislative mandates and draw up a proposal for its statewide implementation (Schoßleitner 2016: 3). The delineation of the areas called 'Alpine quiet areas' by the author is based on exclusion zones and relates only to areas of non-permanent settlement, to regions outside of or above areas of permanent settlement (Schoßleitner 2016: 5). A generalised delineation of these spaces results in a transition area between the intensively and extensively used areas.

Alpine quiet areas are topologically specified according to predefined categorisations based on compatible and incompatible uses: 'The classification of the compatibility of uses was based on comparable approaches' (Schoßleitner 2016: 61). These included the Alpine Plan, white zones, the Tyrolean quiet areas, the Alpine quiet areas in the Tennengau regional programme *(Regionalprogramm Tennengau)* and last but not least the usage regulations for conservation areas (Schoßleitner 2016: 12). Not only uses but also activities (e.g. heliskiing) are judged as compatible or incompatible by a classification that takes place in an iterative process. Suggestions in relation to compatible or incompatible uses were submitted and internally discussed with the department of spatial planning (*Raumplanung*) or the responsible department in the government of the federal state of Salzburg (Schoßleitner 2016: 12). Examples of the compatible and incompatible uses that were determined are listed in Table 5[17]:

Compatible uses	**Incompatible** uses
Footpaths, via ferratas, cycling paths, natural sleigh runs, ski mountaineering routes, cross-country ski tracks, Alpine and hiking paths, mountain paths, bridle paths, small sport facilities, minor transport routes whose main use is not private motor vehicle traffic, agriculture and forestry operations (ecologically oriented or extensive), forest roads, unpaved car parks smaller than 1,000 m²	Ski runs and accompanying infrastructure, summer and winter sleigh runs, leisure and entertainment parks, motorsport or shooting facilities, roads for private motor vehicle transport (major national or state roads, roads of supra-local importance, local roads, private and toll roads for public use), areas of raw material extraction

Table 5: Compatible and incompatible uses of Alpine quiet areas / Source: Schoßleitner (2016: 17 et seq.).

In a further step, the uses are allocated to existing and binding area designations, for example according to regional development strategies. Areas with the potential to be Alpine quiet areas are then positioned diametrically opposite incompatible exclusion

17 For a complete listing of the compatible and incompatible infrastructures and uses, cf. Schoßleitner (2016).

zones, thus establishing the spatial relationship (Schoßleitner 2016: 30, 63). In summary, Alpine quiet areas based on the Salzburg model are defined as the areas of non-permanent settlement minus the exclusion zones (Schoßleitner 2016: 61).

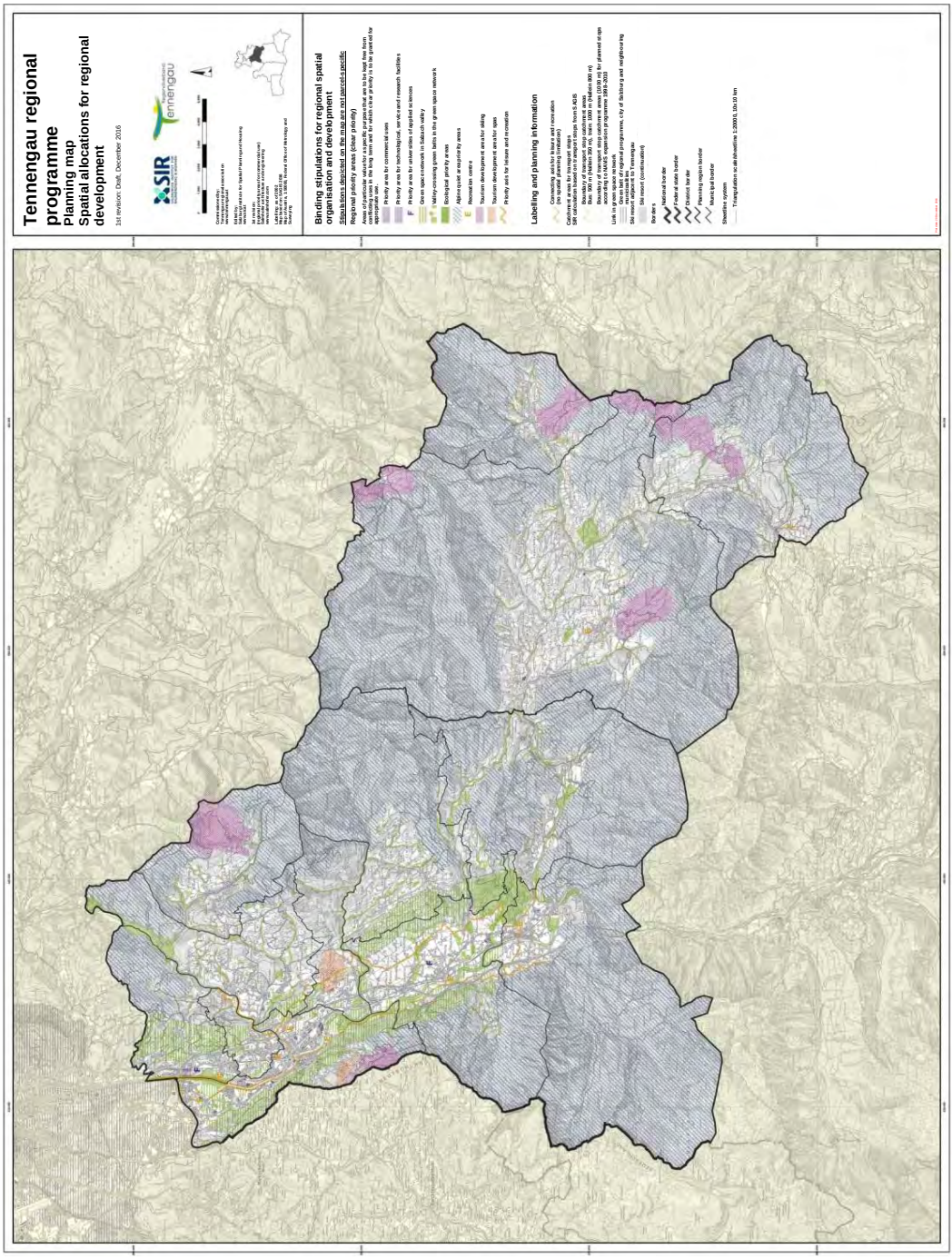

Fig. 5: Spatial allocations for regional development in the federal state of Salzburg, exemplified by the Tennengau regional programme (priority zones for Alpine quiet area in dark blue hatching) / Source: Tennengau regional association (2002: 8 et seq.).

Setting the boundaries of Alpine quiet areas and designating them in planning documents follows the same principle as that used to determine compatibility and incompatibility – in this case by assessing whether a use that is in principle compatible with an Alpine quiet area conforms with a specific area designation. The result was that 'a compact compilation of "zones with Alpine quiet area potential" and "Alpine quiet area exclusion zones" was created' (Schoßleitner 2016: 30). However, to avoid an excess of information on planning maps, only large exclusion zones such as ski resorts or supra-local public thoroughfares are used. It should also be noted that the state-wide cartographic representation 'is limited to a purely graphical rendition; it contains (for example) no new delineations, digitalisation or buffer calculations' (Schoßleitner 2016: 49).

The Alpine quiet area instrument in the federal state of Salzburg is anchored in both spatial planning and nature conservation. 'Alpine quiet area' as a spatial planning designation was first adopted in 2002 in the Tennengau regional programme established by the Salzburg state government (*LGBl.* [State Law Gazette], No. 60/2002) (cf. Fig. 5). Thus far, this is the only regional programme in the federal state of Salzburg in which an Alpine quiet area regional priority zone is designated in a binding stipulation for spatial planning and development that applies over an entire region. This stipulation imposes a mandatory requirement that all affected municipalities include Alpine quiet areas in their spatial development strategies at the municipal level.

Salzburg's 2003 Federal State Development Programme initially adopted the measure of designating such areas in landscape protection and landscape development (natural areas, open spaces, landscapes) with the definition of objectives and the formulation of a coordinated measure for designating Alpine quiet areas. Regulations at the regional or local level would then have to be implemented in the regional programme and/or the spatial development strategy (Schoßleitner 2016: 10 et seq.). The designation of Alpine quiet areas also defines final limits of development for intensive uses. These limits serve to safeguard as yet largely undeveloped areas and are directed at infrastructure-intensive tourism, transport and energy industry uses. Their aim is to concentrate the development zones for intensive uses in small areas (Schoßleitner 2016: 9, 16, 19).

6.2 White zones in Vorarlberg

The untouched natural and cultural landscapes in Vorarlberg are under increasing pressure from various uses. As a result of the increasing use of the landscape by tourism infrastructure, roads and paths, or the expansion of settlements, there are very few undeveloped landscape areas left in Vorarlberg. In 2012 the Federal State Government of Vorarlberg therefore charged its departments for spatial planning (*Raumplanung*) and building law and for environmental and climate protection with recording untouched, semi-natural and little-developed Alpine landscape areas as Alpine open spaces (first phase) and safeguarding them for the long term as 'white zones' (second phase). The white zone inventory (first phase) represents a detailed description of each natural and cultural space and the uses of little-developed moun-

tain landscapes in Vorarlberg. The areas listed in the white zone inventory are based on natural spatial units (hydrologically and geographically discrete landscape units) and not on administrative boundaries since human perception is subjective and strongly influenced by landscapes.

In the long term, new large-scale landscape-altering infrastructure is to be avoided in selected areas while upholding the principle of accessibility so that both local residents and visitors can experience them (e.g. hiking, ski mountaineering). In addition, sustainable use for agriculture, forestry and hunting in these areas needs to be continued and improved (Kopf/Marlin 2016: 3 et seq.). Intact nature and landscapes are viewed as key capital for the quality of life in Vorarlberg. Undeveloped areas are important for both conservation and year-round tourism. The associated commitment to the establishment of white zones is anchored in Vorarlberg's 2020 tourism strategy and in the Vorarlberg state government's work programme for 2014–2019. The federal state parliament resolution of 13 April 2016 called on the Vorarlberg state government to 'designate a white zone in consultation with the affected municipality' based on the white zone inventory (Vorarlberg State Parliament: 3).

The degree of infrastructural development of landscape units provides the methodological framework for the analysis of the areas described in the inventory. The selected approach is based on a GIS-supported method. The analyst's subjective spatial perception or regionally varying knowledge of the territory have little influence on the results.

The definition of the landscape units and an initial calculation of the degree of infrastructural development for Vorarlberg were done by the Grabher Environmental Office (UMG 2008) in 2008 on behalf of Vorarlberg's Nature Conservation Council (*Naturschutzrat*). The existing methodology was refined in two other calculations (2014, 2015) by the Vorarlberg state government's department for spatial planning and building law, which also performed a major revision of the data for roads and buildings. Since infrastructure close to the borders can influence the degree of the infrastructural development of landscape units in Vorarlberg, such infrastructure was included in the latest calculation of the degree of infrastructural development in October 2015. In addition, the degree of infrastructural development was determined for all landscape units bordering on the territory of Vorarlberg.

The steps and particularities of the methodology are described below.

A Calculation of landscape units

The landscape units derived from the digital elevation model form the basis for the delineation of the white zones. Landscape units are natural spaces defined by local topography such as valleys, cirques or ravines. Since topography also determines surface drainage, catchment areas are a suitable means of delineating landscape units. Using the digital laser-scanned elevation model from 2011 (VoGIS [Vorarlberg GIS] 2016, resolution 5x5 m), Vorarlberg was divided into around 20,000 small

catchment areas, which were then manually combined into larger hydrological units. The result is 681 landscape units with an average area of 3.3 km². They range in size from 0.27 km² for the smallest landscape unit to 25.5 km² for the largest landscape unit (cf. UMG 2008). The technical procedure for calculating the landscape units is documented in detail in UMG (2008: 7 et seq.).

B Selection of infrastructures

The degree of infrastructural development was calculated using the data available in VoGIS. To improve the quality of the input data, the rural road network was supplemented with additional roads visible in aerial photography from 2012. In the area examined for the first calculation in 2014 (core, buffer and development zones), all infrastructure data was checked and refined using aerial photography from 2015 and then the degree of infrastructural development was recalculated (final calculation: October 2015).

The following infrastructure was included when calculating the degree of infrastructural development:

> road network (state roads, local roads, motorways, forest and supply roads, private roads);

> mechanical lifts and ski runs;

> goods cable lifts;

> reservoirs and overhead electrical power lines;

> address points and/or buildings of over 200 m²;

> railway tracks;

> building sites in the preparatory land-use plan (building sites for core areas, residential areas, mixed use areas, commercial areas).

C Degree of infrastructural development of landscape units

All areas within a 200 m buffer around point, line and area infrastructures are considered developed. For example, the developed corridor for a road or cable car is 400 m wide. The developed areas' percentage of a landscape unit's total area yields the degree of infrastructural development. This is done in three steps.

> A 200 m buffer is calculated for each of the ten aforementioned infrastructure datasets and amalgamated into a single polygon (infrastructure buffer).

> The infrastructure buffer is combined with the landscape units.

> The infrastructure buffer's proportion of the area of each landscape unit is calculated (infrastructurebuffer_landscapeunit_ID (m^2)).

The degree of infrastructural development is then calculated as follows for each landscape unit:

$$\text{Erschließungsgrad [\%]} = \frac{(Infrastrukturpuffer\ (\text{Landschaftskammer\_ID})\ [m^2]}{(Landschaftskammer\ [m^2]} * 100$$

D White zone categories

There are three categories: core, buffer and development zones. A white zone (= descriptive unit) can consist of multiple such zones.

> Core zones comprise undeveloped or little-developed landscape units with a degree of infrastructural development of 0–20%.

> Buffer zones comprise undeveloped areas with a minimum size of 2 ha that are adjacent to the core zone (inside or outside the state territory) but are themselves in a landscape unit with a degree of infrastructural development exceeding 20%.

> Development zones correspond to the developed area around infrastructure (400 m corridor) in landscape units or valleys with a high landscape value and a degree of infrastructural development between 20% and 30%. This third white zone category was introduced so that valleys with a high proportion of buffer zones that have a very untouched and semi-natural character but a degree of infrastructural development exceeding 20% can be included and described in their entirety. Development zones were designated in seven valleys with a degree of infrastructural development between 20% and 30%. To characterise a valley, both the undeveloped buffer zones and the developed areas in its description must be included.

E Thresholds

A wide range of factors determines the effects of an item of infrastructure: the protected asset in question, local topography, and of course the intensity of human use and even the season. The available information about infrastructures – especially unavailable data about frequency of use – do not allow a nuanced assessment of the impact of an item of technical infrastructure on the scenery and the environment. The selected thresholds are based on considerations related to ecology and scenery because an infrastructure's land take in relation to these two aspects in an otherwise little-developed landscape is usually much greater than the area actually required by the infrastructure.

A buffer of 200 m around all infrastructures – regardless of their type – must be seen as an assumption that yields a plausible result with respect to the most important protected assets. The selected calculation method is also relatively flexible. Differently selected buffer distances do not significantly affect the result.

The threshold of a maximum developed area of 20% for the core zones is based on the assumption that three quarters to four fifths of a landscape should be undeveloped if it is to be perceived as a natural and relatively undisturbed area. This value also shows relatively high flexibility; if the threshold is raised to 25% or 30% or lowered to 15%, the result remains spatially similar and the overall picture changes only slightly. Given this, one can conclude firstly that a maximum degree of infrastructural development of 20% yields a spatially coherent result and secondly that minor deficits in the input data do not significantly affect the overall picture.

Specifying a minimum area of 2 ha as the minimum buffer zone area is intended primarily to take aspects of wildlife ecology into account. This minimum size is needed so that such areas can be considered refuge areas.

To examine the threshold value's effect on the size of the research area, the parameters for buffer width and degree of infrastructural development were adjusted in multiple runs of the model. It can be seen that the threshold values have little influence on the spatial extent of the little-developed areas. The positive feedback effects of infrastructures and uses are an important reason for the threshold values' relatively low influence on the overall result. Similar development patterns occur frequently. For example, if a landscape unit has not undergone basic development, there will be no follow-up development and any use will be mostly extensive. As a result, landscape units with a 'medium' degree of infrastructural development between 20% and 80% are rarer than those with a high (over 80%) or low (below 20%) degree of infrastructural development.

F Consolidation of core, buffer and development zones into descriptive units and inventories

The white zone inventory comprises 83 individually documented descriptive units. A white zone (= descriptive unit) can consist of multiple core, buffer and development zones. Each descriptive unit consists of an area description and a usage description. These descriptions address numerous aspects (area: position, landscape units and infrastructures, geology, climate, flora and fauna; use: agriculture, forestry, hunting, tourism and recreation, water management, flood and avalanche control, historical mining). An informative topographic map provides an overview of the most important infrastructures and uses, complemented by interesting digressions on area-specific aspects. The title page summarises a white zone's most important parameters; polar area diagrams enable a quick comparison of the white zones in terms of their total area, proportion of undeveloped land, proportion of conservation areas, connectivity with other white zones, and remoteness. This also enables an overall graphical assessment of the areas in terms of these characteristics.

G Results

The extent to which individual landscape units are affected by infrastructure is indicated by their degree of infrastructural development (see the explanation of the methodology above). Only around 6% of the area of Vorarlberg's landscape units is undeveloped or has only negligible infrastructure (range 0–5 %). Around 19% of the landscape unit area is less than 20% developed, corresponding to little-developed or undeveloped landscape units, and 40% of the landscape units (core zones) have a very high infrastructure density with a degree of infrastructural development exceeding 80% (range > 80%) (cf. Fig. 6).

> 20,171 calculated catchment areas were combined into 681 landscape units (UMG 2008: 15).

> 6% of Vorarlberg's territory is currently undeveloped. Almost one third of Vorarlberg's land area corresponds to little-developed or undeveloped natural and cultural landscapes (white zones), and 40% of the landscape units have a very high infrastructure density with a degree of infrastructural development exceeding 80% (Kopf/Marlin 2016: 4 et seq.).

> 14% of the white zone area is forested, 28% is used for agriculture, and over 50% is barren Alpine land (Kopf/Marlin 2016: 4 et seq.).

> The potential for particularly valuable landscapes that are worthy of protection (small and large biotopes) is especially high in the white zones. Nearly one third of Vorarlberg's land area is designated as small or large biotopes; their share in the white zones is nearly 50%.

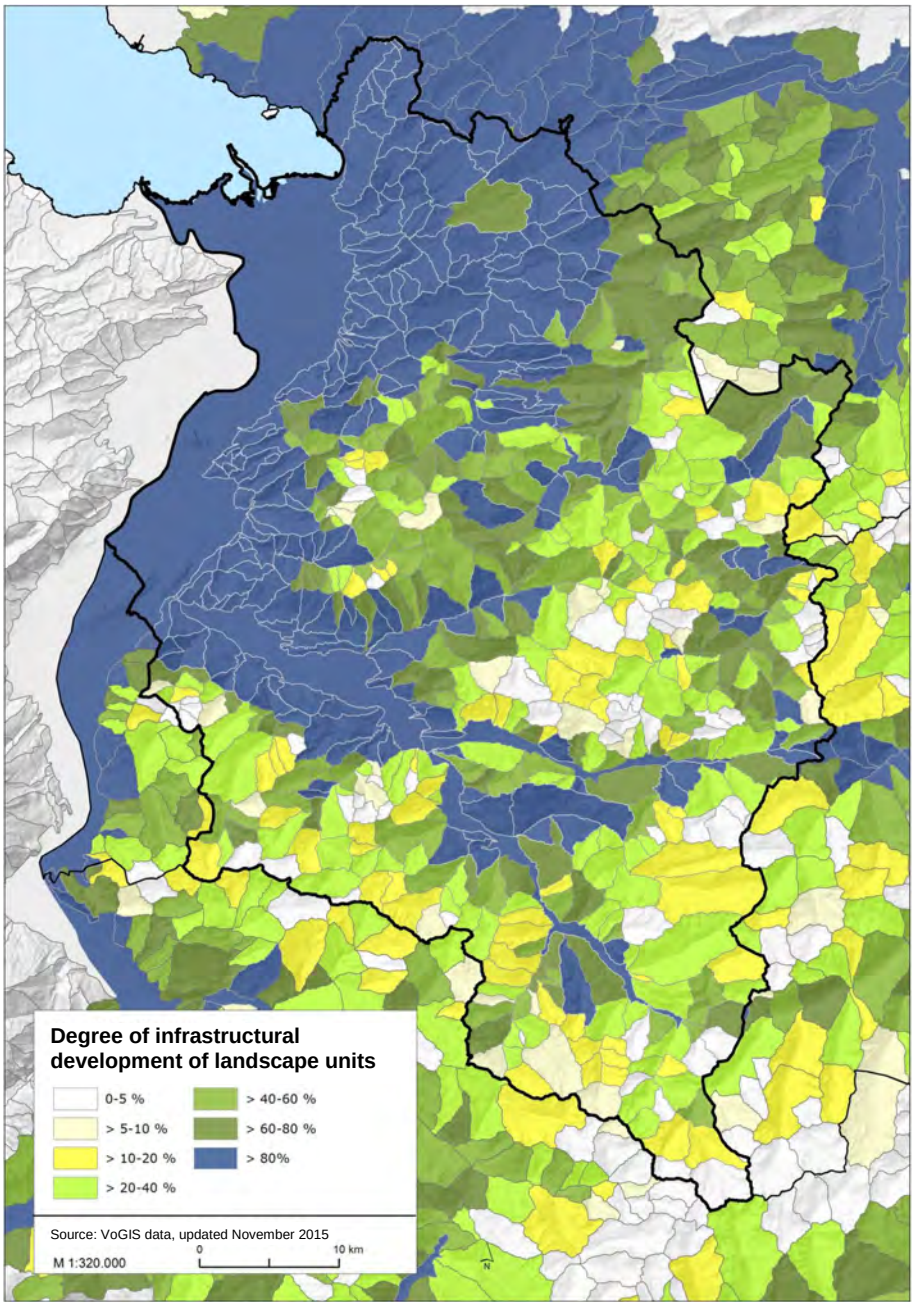

Fig. 6: Degree of infrastructural development in the landscape units in Vorarlberg

> Around 19% of the land area is protected (e.g. Natura 2000, flora or local conservation areas). By way of comparison, the proportion of protected areas in the white zones is considerably higher at around 30%.

> Today no place in Vorarlberg is more than 2,830 m (straight line distance) from the nearest road.

> With regard to tourist use and value for people seeking recreation, there are major differences in the white zones. The white zones provide a wide range of leisure and recreational uses, including freeriding, popular mountain hiking routes, and remote and sporadically visited retreats. There are no mechanical lifts in the white zones. However, numerous uses in white zones originate with cable cars in the immediate vicinity of white zones (e.g. freeriding hotspots, climbing centres).

> The importance of the researched areas in the white zone inventory is very important for hunting since many of the large wild animals in Vorarlberg retreat to the little-developed mountain areas.

Vorarlberg's white zones: from the initial idea to the current state of affairs

The degree of infrastructural development of landscape areas was surveyed and analysed in a study on the delineation and development of landscape units in Vorarlberg (UMG 2008), which was commissioned by Vorarlberg's Nature Conservation Council. This and the Council's periodic reports were the starting point for the white zone project.

From the beginning, work on the various inventory categories involved other federal state departments as well as other agencies and stakeholders (cf. Fig. 7). A workshop on white zones took place at the University of Innsbruck (Institute for Geography) in February 2015. The idea of white zones, the methodological approach and the value of little-developed Alpine landscapes were discussed in a scientific expert group comprising various disciplines.

Parts of the project were assigned to external agencies. A survey of the most important tourism stakeholders and cable car operators in Vorarlberg had a considerable impact on the sentiments relating to the white zone project. In this context, the first concrete maps of the inventoried areas were circulated to people outside of the state administration. In spite of emphatic clarification about the difference between making an inventory and potentially implementing it, this had a serious negative impact on the general attitude towards the project; its acceptance plummeted, especially among the tourism stakeholders. Because of winter tourism's importance for Vorarlberg and worries about limits being imposed on ski resort development, some municipal officials and tourism stakeholders immediately expressed categorical opposition to the project.

The distribution and disclosure of cartographic materials – and use of the term 'white zone inventory' – led to premature discussion about implementation. The intended discussion about the value of untouched landscapes thus gave way to an

emotional and interest-driven debate, often without relation to facts. It should be noted that there was considerable criticism about inventories even at the very beginning of the project. Statements such as 'An inventory will have an impact, with or without legal backing' were often heard. In this context, reference was always made to the biotope inventory, which serves as an important foundation for opinions on conservation in Vorarlberg. In addition, many farmers and foresters had serious reservations that, after the nomination of the Natura 2000 areas in the summer of 2016, they would be confronted with another stumbling block in the form of the intended white zone plans.

Due to intense resistance from influential stakeholders such as cable car operators and farmers and the frequent failure of important partners such as conservation organisations, the Alpine Club and game management to take a position, imminent implementation should not be expected. The most important (tourism) municipalities (important because they have the largest white zone areas) have thus far usually also been critical of inventories and have always expressed negative views about any spatial planning implementation. Finally, due to the resolution by the Vorarlberg State Parliament on 13 April 2016, according to which no legally binding designation of white zones is to take place without the consent of local authorities, across-the-board implementation should be considered unlikely in the near future. Even so, efforts are underway to ascertain whether implementation in selected pilot areas is possible. The pilot areas would be used to work out specific requirements and objectives and test implementation in practice.

White zones have become the subject of widespread and intense criticism due to conflicting land use interests and the reservations of cable car operators, agriculture and forestry representatives and various landowners about potential constraints on their freedom of action. Though the project is generally considered useful, it is difficult to convince the concerned parties of the value of semi-natural, undeveloped landscapes as such and of the usefulness of anchoring them in legislation. Despite many innovative attempts at external communication (the 'Wild Vorarlberg' card game, information events, involvement of relevant government departments, presenting the project to various opinion leaders such as chambers of commerce and agriculture), efforts to explain how valuable and worthy of protection little-developed Alpine open spaces are have clearly been insufficient. Either the clear distinction between inventory and implementation was not perceived or the inventory as an analysis of the current state of affairs was seen as a restriction. The fact that the inventoried areas are still undeveloped today is often seen as an argument that the municipalities and the valley inhabitants have managed their land sustainably over the centuries. Currently there are plans to publish a white zone inventory before the end of 2017. It will not be legally binding from a spatial planning perspective but will provide an important basis for expert reports by specialists.

In the end, there needs to be a critical examination of whether spatial planning implementation of white zones throughout Vorarlberg would have been possible even if the initial situation had been more favourable and concerted efforts to inform the public and raise awareness of the issue had been more successful. A

sceptical attitude on the part of local authorities towards an ordinance applying to all of Vorarlberg, which would constrain their planning autonomy, is understandable. A process with broad participation by various interest groups with standpoints that are often diametrically opposed (e.g. cable car operators) makes state-wide planning for reserved areas a delicate balancing act for politicians.

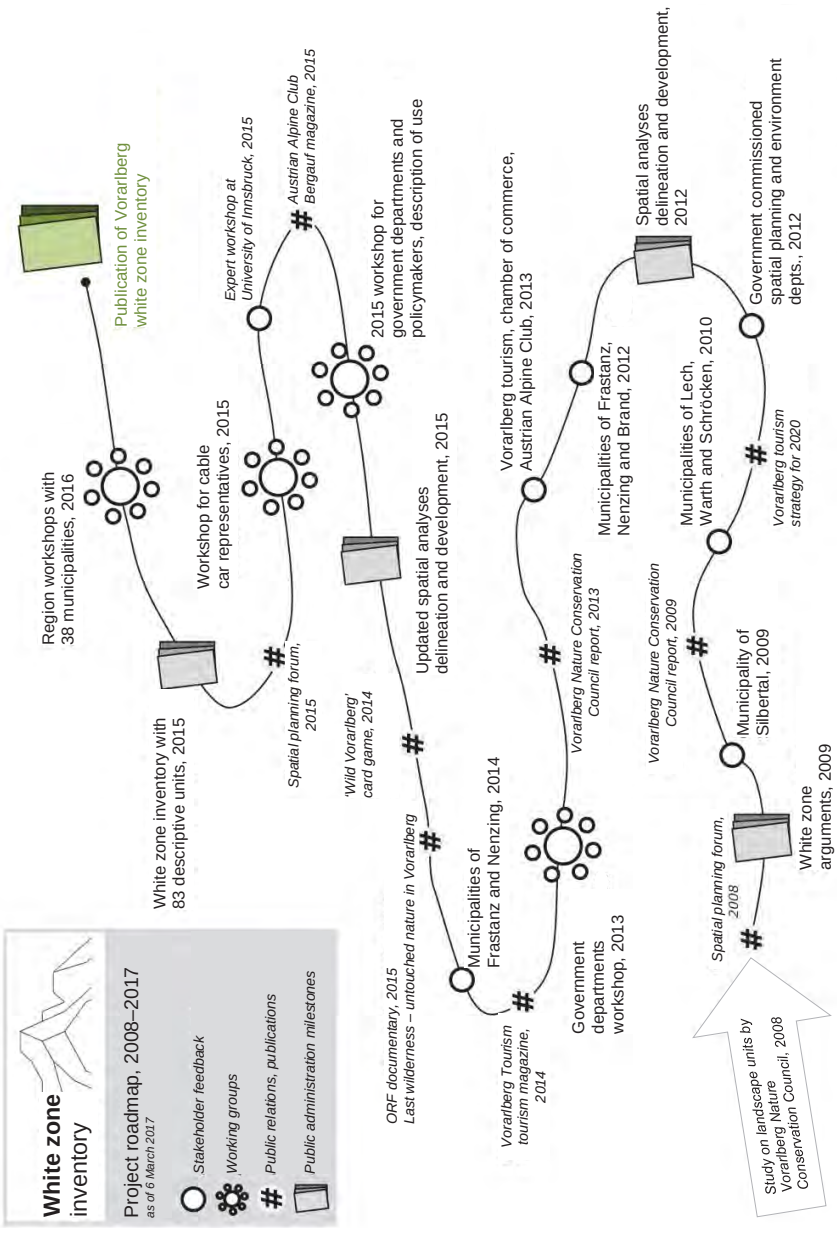

Fig. 7: White zone project roadmap, 2008–2017

6.3 Undeveloped areas in South Tyrol

The aim of the 'Undeveloped areas in South Tyrol' project is to identify undeveloped areas and residual areas within the developed areas. The project received financial backing from the autonomous province of Bolzano – South Tyrol, and was developed by Trifolium (an environmental consultancy) in cooperation with the South Tyrol Nature Museum. Undeveloped areas are open spaces without developed infrastructure, i.e. free of infrastructure but not of ecological effects from neighbouring infrastructure (Kußtatscher/Breitenberger 2010: 3). In principle, one can speak of a landscape ecology approach as there are no biotope maps for South Tyrol. The project's objective was not to draw general conclusions about fragmentation but to identify the natural residual areas without infrastructure in South Tyrol (Kußtatscher/Breitenberger 2010: 35). For the most part, transport infrastructure and settlement areas were examined (cf. Table 6).

Infrastructures examined
Motorways, railways, national roads, state roads, municipal roads, cycling paths, forest and Alpine paths, supply paths, private streets, other road infrastructure, roads under construction and settled areas

Table 6: Infrastructures examined / Source: Breitenberger (2010: 3 et seq.).

The dataset for the traffic routes was provided by the supra-local spatial planning office of the autonomous province of Bolzano – South Tyrol. The various elements (motorway, cycling path, forest path, etc.) were combined into one category. Hiking paths and tunnels could not be considered as the dataset for them is too incomplete (Kußtatscher/Breitenberger 2010: 36 et seq.). Tourism infrastructures such as ski runs, mechanical lifts and hiking paths were only used for a later visualisation (Kußtatscher/Breitenberger 2010: 45). The data for the settlements was extracted from the WebGIS of the autonomous province of Bolzano – South Tyrol (Kußtatscher/Breitenberger 2010: 45). South Tyrol's land area in polygon form served as a baseline (Kußtatscher/Breitenberger 2010: 47). Then the transport infrastructures (polyline) were furnished with a buffer of 5 m. The various buffered infrastructure classes were combined with the South Tyrol polygon (Kußtatscher/Breitenberger 2010: 47). In the next step, the settled areas without buffers were subtracted from the surface to differentiate the as yet undeveloped areas (Kußtatscher/Breitenberger 2010: 52). The process concluded as all areas smaller than 100 ha were excluded and the analysis was verified and corrected with aerial photography from 2006. These small areas correspond to around 11% of the total area of all identified areas (Kußtatscher/Breitenberger 2010: 52 et seq.). In total, 487 undeveloped areas with a total area of 6,245 km² were identified (Kußtatscher/Breitenberger 2010: 55). These areas cover around 84% of South Tyrol's land area (cf. Fig. 8).

The largest undeveloped areas are in northern South Tyrol, on the border with Austria in Vinschgau and in the Tauferer Ahrntal in the high altitudes of the main crest of the Alps and of the Ortler Group. Smaller undeveloped areas can be found mainly in the region between the urban space around Merano and Brixen, in the vicinity of Sulden and to some extent in the Dolomites; the highly developed transport

infrastructure there is readily apparent. The Etschtal valley in the west and south and the Eisack and Rienz river valleys in the north and east of South Tyrol make clear cuts in the landscape areas and are developed. Extensive development can also be found in the agglomerations of Bolzano, Merano and Brixen. Around these places, the undeveloped areas are much smaller with respect to the overall region; the smallest undeveloped areas in particular appear to be dispersed at points throughout the space (cf. Fig. 8).

In the study, the undeveloped areas were divided into six size classes. The two small classes cover 100–500 ha and 500–2,000 ha, the medium classes 2,000–10,000 ha and 10,000–50,000 ha, and the two large classes 50,000–100,000 ha and 100,000–120,000 ha (Kußtatscher/Breitenberger 2010: 56). The most common are the undeveloped areas of 100 to 500 ha. Together with the areas of 500 to 2,000 ha, they amount to around 23% of all identified undeveloped areas and around 19% of the land area (n = 461). The two medium size classes number 23 areas (approximately 29% of all areas and 25% of the land area). The two large classes total 48% of all undeveloped areas and 40% of the land area (n = 3). In the smallest class of undeveloped area (100–500 ha), the average size of the areas is 206.5 ha. They comprise 71% forest, 22% cultural landscape and 5% grassland (Kußtatscher/Breitenberger 2010: 58). The next largest size class has similar shares of forest (73%), cultural landscape (12%) and grassland (9%) areas. The average size is 948 ha (Kußtatscher/Breitenberger 2010: 56 et seq.). There are only a few large areas (over 50,000 ha) (Breitenberger 2010: 3 et seq.). In the other larger classes, the average size of the undeveloped areas rises from 3,856.87 ha (2,000–10,000 ha) to 17,371.11 ha (10,000–50,000 ha). The class for 50,000 to 100,000 ha has only a single area with a size of 66,520.95 ha. The largest areas (class 100,000–120,000 ha) are covered by 31% rock, glaciers and loose material, 28% grassland, 34% forest and 5% cultural landscape (Kußtatscher/Breitenberger 2010: 59 et seq.).

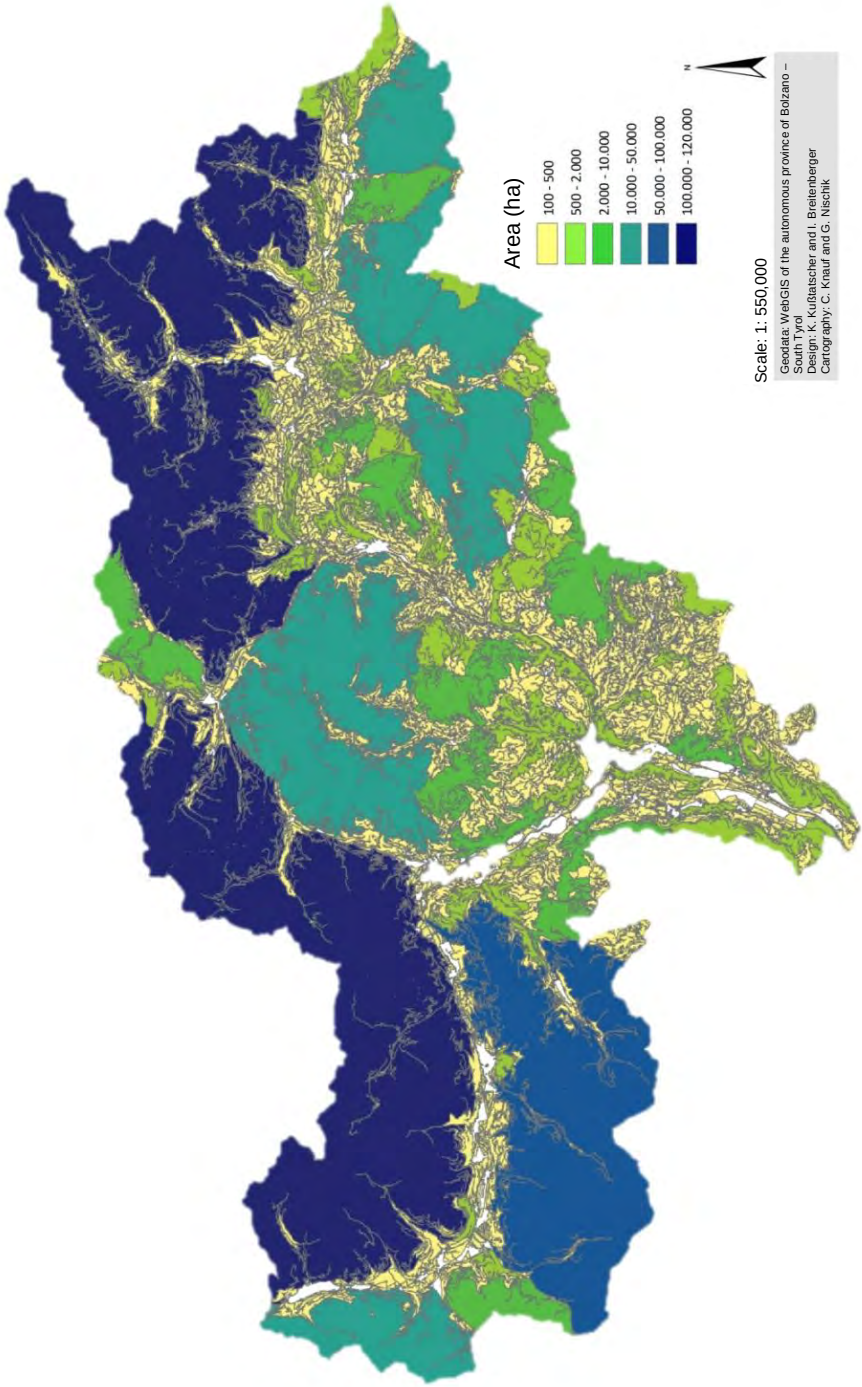

Fig. 8: Undeveloped areas in South Tyrol

In summary it can be said that forest dominates the ground cover, except in the 10,000–50,000 ha class. In the classes up to 10,000 ha, forest covers more than 50%; in the classes from 50,000 to 120,000 ha it covers more than 75%. The fraction of areas covered by rock and glaciers (including loose rock) increases steadily from the small to the large area sizes. Cultural landscapes cover less of the large areas than of the small ones. Waters and wetlands cover only small parts of all areas. The smaller undeveloped areas (100–2,000 ha) are in low to middle altitudes. This is reflected in the large share of cultural landscape and in the small share of grassland, rock, glaciers and vegetation-free loose material (Kußtatscher/Breitenberger 2010: 64). There are very few large undeveloped areas left in South Tyrol, mostly at higher altitudes. Here, however, the undeveloped areas are an important requirement for biodiversity because they provide refuges for species and populations. Due to continued development, there is considerable potential for conflicts in the valleys in particular, so these undeveloped areas should be the subject of further discussions in planning processes. A striking figure in South Tyrol is the high road density of 2.56 road kilometres per square kilometre of land area, with frequent dead-end paths to be seen. These are paths that cut into an area but not completely through it, thus they end in the middle of an undeveloped area. Spaces within the undeveloped areas in which no dead-end paths are to be found are called core areas. In this study, too, undeveloped does not mean untouched: even these areas are not completely free of human impact. Undeveloped thus merely means 'free of transport infrastructure'. In future, special attention should be paid to the undeveloped (small) areas on valley floors and to the (medium-sized) areas on the slopes (Breitenberger 2010: 3 et seq.).

A major problem for South Tyrol is the further development of open spaces for ski resorts. The cable car sector is in a state of 'high-altitude euphoria'. '"In all of Trentino, Belluno and the Aosta Valley there is not as much renovation and construction of lifts as is now going on in South Tyrol", says the state office for cable cars' (Larcher 2016: 34). The business model of heavy investment is well known. However, it must be asked whether, given climate change (warmer winters with less snow), higher operating expenses (snowmaking equipment) and decreasing numbers of skiers, it is even possible to shape the future of ski tourism in a positive and sustainable fashion with ever-increasing investments and massive encroachments on the environment. Profits are expected from the high investments in cable cars and ski lifts. But 'I think it's wrong to believe that ski infrastructure development or connecting ski resorts is the solution for every structurally weak area', said Arno Kompatscher, head of South Tyrol's government (Larcher 2016: 35). On the contrary, according to studies, it is through 'soft' tourism that profits are to be made (Larcher 2016: 27 et seq.).

6.4 Semi-natural open spaces in Switzerland

Both the intensity of use in Alpine open spaces – the (still) undeveloped and semi-natural landscape areas in the Swiss Alps – and the pressure to exploit them are high. 'In Switzerland there are almost no places left that have not been reshaped in some way by humans' (FOEN/WSL 2013: 8 et seq.), as in the other Alpine states. In addition, the topography features high relief that severely limits land use and spatial development, leaving limited amounts of land available as locations for uses of any kind. The

Swiss Alps are both a living space and a recreational area and face the challenge of protecting the natural landscape and cultural heritage on the one hand and promoting tourism, energy generation and other (economic) development on the other. This means that the diverse interests of various stakeholders need to be balanced while minimising land take and further landscape fragmentation. As a result, one task of several for spatial planners is to protect the (remaining) semi-natural open spaces.

The analysis of the Swiss Alpine region was performed by the Swiss Federal Institute for Forest, Snow and Landscape Research *(Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft, WSL)*. The research area covers the Swiss Alps in accordance with the areas specified in the Alpine Convention, including the cantons of Graubünden, Uri, Tessin, Wallis, Waadt, Freiburg, Bern, Luzern, Obwalden, Nidwalden, Schwyz, Glarus, St. Gallen, Appenzell Innerrhoden and Appenzell Ausserrhoden. The aim of the study was to identify the (remaining) semi-natural open spaces (and the transformed open spaces and developed areas) in Switzerland using GIS-assisted analyses and to assess them quantitatively and qualitatively. The (GIS) analysis includes four steps:

> (methodological) operationalisation of semi-natural open spaces (cf. Chapter 2),

> classification of spatially relevant disruption by objects in the landscape through the differentiated selection and buffering of infrastructures,

> identification of the degree of infrastructural development of individual subdivisions,

> identification of semi-natural and transformed open spaces in the research area and classification of all landscapes in the Swiss Alps as 'semi-natural open spaces', 'transformed open spaces' and 'developed areas' based on their degree of infrastructural development.

In order to determine the degree of infrastructural development and spatially relevant disruption by infrastructures (the methodological foundation of the analysis), the spatial units in Switzerland had to be delineated as a reference surface first. Sub-catchment areas from the Swiss Federal Office for the Environment (FOEN) were used for the delineation of these spatial units (FOEN 2016). The advantage of this method is that the evaluation is based not on administrative boundaries but on hydrological and geographical spatial units since landscape areas, open spaces, natural landscapes and cultural landscapes are strongly affected by both anthropogenic landscape transformations and (indirectly) by human percep-tions of spaces. In addition, the 2014 swissALTI3D digital elevation model (excluding ground cover and buildings) with a grid size of two metres and the Swiss coordinate system LV03 and altitude system LV02 was used to record the altitudes and slope gradients.

All of the infrastructure data from the Swiss Topographic Landscape Model (TLM) were used to analyse the infrastructures. The TLM with its three-dimensional geodata is the basis for countrywide geodata production (update cycle six years) and is produced directly from aerial photography (swisstopo [Swiss Federal Office of

Topography] 2017). The model includes databases with different classes of infrastructure (e.g. recreational facilities) that in turn consist of various elements (e.g. caravan sites, golf courses, athletic grounds).

The following TLM infrastructure databases were used for the analysis: recreational facilities, developed areas, transport infrastructure, buildings, high-voltage power lines, linear sport facilities and athletic grounds, selectively built service buildings, dams, railways (excluding tunnels), mechanical lifts, roads (excluding tunnels).

Point, line and area infrastructures (e.g. antennae, roads, airports) can have very diverse impacts in their spaces, and planners must decide whether such technical infrastructure is to be classified as 'disruptive' or 'non-disruptive' to the character of semi-natural open spaces. Such decisions must take into account the fact that any item of infrastructure always has ecological and aesthetic effects on the greenfield land take beyond the scope of its own land development. The greater this spatial disruptive effect is, the more buffering is needed around the infrastructure. The disruption can be measured by physical criteria or subjective perception. Since semi-natural open spaces are to be preserved for purposes such as recreation and also for forestry, agriculture and hunting, i.e. nature-friendly uses, it is possible to identify spatially relevant, non-disruptive infrastructures such as summit crosses, unpaved paths up to two metres in width, nurseries, and religious and historical structures (cf. Table 7) that thus do not need to be taken into account when determining the degree of infrastructural development and buffers and are irrelevant to the intended use of the semi-natural open spaces.

Non-disruptive infrastructures
2 m path, 2 m path fragment, 1 m path, 1 m path fragment, marked trail, via ferrata, nursery, cemetery, historical area, historical building, chapel, sacral tower, sacral building, monument, ferry, car ferry, pedestrian ferry, caravan site, public park, orchard, unplanted forest, wayside shrine, well, summit cross, grotto, cave, spring, survey pyramid, waterfall, water supply, water basin, river control structure, avalanche control structure, water channel, penstock, wall, transport cable

Table 7: Non-disruptive infrastructures

The Swiss Landscape Observation Programme *(Landschaftsbeobachtung Schweiz, LABES)* performed a qualitative differentiation of the disruptive effects of point, line and area infrastructure. LABES is a programme of the Swiss Federal Office for the Environment; its aim is to gather information about landscape conditions and trends in Switzerland using 30 to 40 periodically surveyed parameters and perception indicators (e.g. urban sprawl, soil sealing, light emissions). Regarding the latter, both the physical and the symbolic/aesthetic aspects of the landscape and infrastructure were rated in a survey of 2,814 households in all of Switzerland's cantons (FOEN/WSL 2013: 19 et seq.). First the survey results on the perception of infrastructures in the landscape were used to analyse their (disruptive) effect. In addition to the subjective classification from this quantitative survey, the spatial disruptive effect of transport infrastructure can be derived from the propagation of noise[18] along public thor-

18 Worst-case scenario = noise propagation measured during the day in summer = 'SonRail_day', applied threshold of 55 db (FOEN 2016: n.p.).

oughfares (roads and railways). The reference value is the threshold of 55 dB above which noise is defined as annoying (FOEN 2009: 14). As an example, noise propagation from railway lines was analysed and the average distance from the line at which the aforementioned threshold is reached was determined. For example, standard gauge trains were assigned a buffer of 500 metres; for light rail and narrow gauge trains the buffer was 200 metres. Visual disruptive effects were not considered in the analysis.

After running the model several times it was observed that changing the buffer classes had only a slight influence on the overall spatial structure (spatial extent and location), for example if the largest buffer class is enlarged from 1,000 to 1,500 m. With the help of detailed aerial photographs, the buffers and the spatial type classifications were subjected to random plausibility checks both when running the model and during the actual study. Each item of infrastructure classified as disruptive was assigned to a buffer class and its impact area was calculated and combined into an infrastructure polygon. Using the ArcGIS data management tools 'merge' and 'dissolve', all polygons of the same buffer class were then combined into a contiguous polygon, resulting in four polygon layers of the four buffer classes. The totality of spatially relevant infrastructures of all classes by disruptive effect was determined as shown below.

> 25 m buffer class: This class includes all buildings that usually generate few or no direct emissions, though nearly every building is connected to the transport network and thus causes indirect emissions. The public thoroughfares themselves are usually assigned to buffer class 2 (200 m).

> 200 m buffer class: This is the standard class for areas whose noise emissions are in some cases disruptive, such as recreational facilities, caravan sites, sport facilities, dams, light railways, and roads three to eight metres wide.

> 500 m buffer class: This class combines disruptive infrastructure with high noise levels and airborne emissions, such as sewage, landfills, resource extraction sites, standard gauge railways, rural roads, cable cars and ski lifts (with a large buffer for ski resorts to take the course of the ski run into account).

> 1,000 m buffer class: All extremely disruptive infrastructures with significant emissions were subsumed into this class, including airports and heliports, motorways and power plants.

Table 8 summarises the various (technical) infrastructures of the four buffer classes.

Buffer class	Disruptive infrastructures considered
25 m	All buildings
200 m	Recreation centres, golf courses, racecourses, swimming pools, sports grounds, emplacements, zoos, aerials, trade show grounds, allotments, schools, universities, hospitals, public car parks, private driving areas, private car parks, rest areas, public thoroughfares, high-voltage lines, bobsleigh runs, running tracks, racecourses, toboggan runs, butts, ski jumps, pressurised pipelines (single), pressurised pipelines (multiple), antennae, reservoirs, dams, weirs, light railways, narrow gauge railways, conveyors, 6 m roads, 4 m roads, 3 m roads, squares, access roads, road links
500 m	Facilities for wastewater treatment, landfills, gravel extraction, clay mining, quarrying, wind turbines, standard gauge railways, narrow gauge railways with standard gauge, gondola cableways, aerial cableways, chairlifts, ski lifts, limited-acess roads, 10 m roads, 8 m roads, motorail trains
1,000 m	Power plants, airfields, airports, aerodromes, heliports, grass runways, hard-surfaced runways, perrons, grass taxiways, hard-surfaced taxiways, motorways, motorway entrances, motorway exits, service stations, service entrances

Table 8: (Technical) infrastructure by buffer class

A sub-catchment's degree of infrastructural development is determined by an analysis of overlaying areas with spatially relevant infrastructure (including various buffers) on the overall area of the spatial unit. In this way, the degree of infrastructural development was calculated for each of the landscape or sub-catchment areas in the Swiss Alps, and the semi-natural and transformed open spaces in the research area were identified and separated from the developed areas (those with a degree of infrastructural development exceeding 20%). This threshold is based on the consideration that around 80% of a landscape should be free of (spatially relevant) development in order to make a semi-natural or nature-like impression on people. It should be noted that the sensitivity is generally low; if the threshold (in terms of developed or undeveloped) is raised or lowered (e.g. to 30% or 15% in this case), this has little effect on the overall spatial impression.

The following spatial types were identified:

> Semi-natural open space: This spatial type is defined as having a 0% degree of disruptive infrastructural development. This value is set so stringently because non-disruptive infrastructures were excluded before calculating the degree of infrastructural development, leading to a lower error tolerance due to the differentiated consideration of the infrastructures.

> Transformed open space: Transformed open spaces have a degree of disruptive infrastructural development of between 0.1% and 20%. They can thus be classified as potentially endangered spaces since the degree of infrastructural development generally increases. There is a high probability that such spaces will soon be affected by further development with spatially relevant disruptive effects and would then have to be classified as the third spatial type.

> Developed area: A degree of disruptive infrastructural development exceeding 20% disqualifies a landscape area from consideration as semi-natural open space and indicates that the space is subject to increased or increasing anthropogenic influences caused by spatially relevant disruptive effects.

Only landscape areas with an area greater than two hectares were taken into consideration. This accounts firstly for the fact that areas at least this large serve as refuges for wild animals, even though smaller areas can also very well be ecologically valuable. Secondly, landscapes need a minimum size in order to fulfil a recreational role and provide a sense of being able to experience nature there. Since Swiss open spaces vary widely, for example in terms of accessibility, remoteness, relief, degree of infrastructural development, quietness and sport infrastructure, there are different spaces for different kinds of nature-friendly leisure and recreational use. To account for ecological networking effects and connectivity (cf. Section 2.1), adjacent areas of the same spatial type (same class of degree of infrastructural development) were combined into larger connected spatial units.

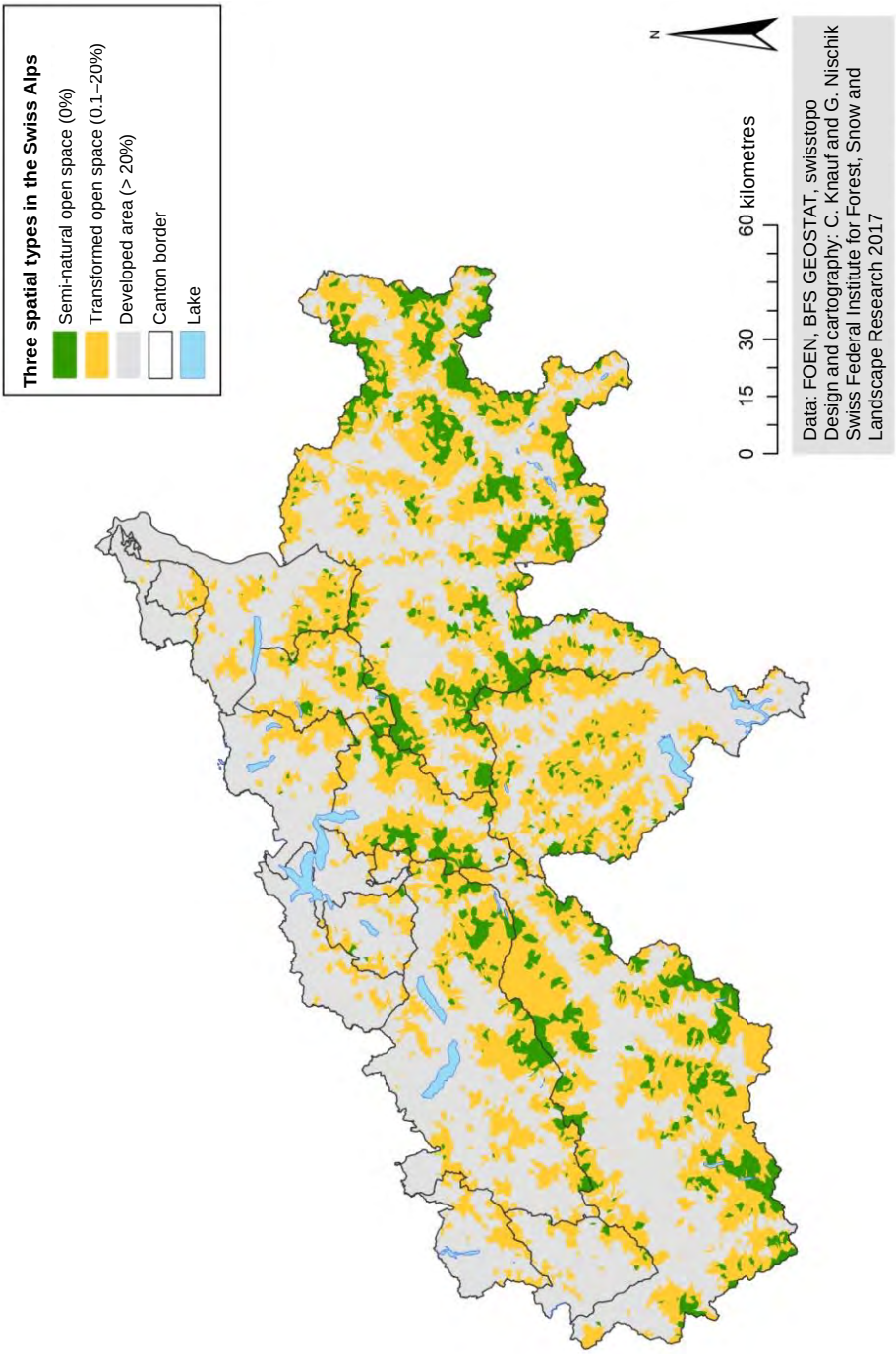

Fig. 9: Spatial types in the Swiss Alps

In total, 415 semi-natural open spaces with a total area of 2,548.6 km² were identified in the Swiss Alps (cf. Fig. 9). Their average size is 61.4 ha. Together they cover 10.1% of the Swiss Alpine region. The 1,075 transformed open spaces have an average size of 87.0 ha and cover a total area of 9,349.4 km², which is 37.1% of the Swiss Alpine region. The low number of developed areas (n = 85) is a result of the methodology ('dissolve' function), which involves combining spaces of the same type. This is the largest category by area, covering a total of 13,299.0 km² and 52.8 % of the Swiss Alpine region. No useful conclusion can be drawn from the average size of these areas. Most of the developed spaces have a high degree of infrastructural development (over 60%).

To elaborate the spatial distribution of the various spatial types in more detail: Semi-natural and transformed open spaces are evidently close together: the semi-natural open spaces are surrounded by transformed open spaces. The transformed open spaces form a (spatial) transition zone between semi-natural open spaces and developed areas. These semi-natural open spaces mainly lie along the main crest of the Alps, which is easily discernible: the Bernese Oberland and the Pennine Alps in the southwest and the canton of Graubünden to the east. The latter has a high percentage of semi-natural open spaces in its south-southwest portion, though these open space structures are divided by the Engadin valley. The valleys are recognisable as developed areas throughout the research area, e.g. Valais and the transport axis from Valais through Uri and Graubünden to Chur in eastern Switzerland. Other extensive developed areas can be recognised in the north, an arc to the south of the agglomerations of Lausanne, Bern and Zurich (southern East Switzerland, Bernese Oberland, southern Central Plateau), and also the Ticino agglomeration around Lugano, which is surrounded by an immense suburban region and is thus shown as a developed area. For transformed open spaces, the danger of further medium- to long-term anthropogenic transformations is clear. For Alpine regions, a particularly striking example is the area around the municipality of Zermatt in southern Valais. As in the other transformed spaces in the Swiss Alps, development for ski tourism is responsible for this. This area is the Matterhorn Paradise ski resort, with an enormous amount of spatially relevant and disruptive winter sport infrastructure and the highest point in the Alps that is accessible via mechanical lift, Gobba di Rollin at 3,899 m.

In order to assess the quality of the identified areas, we conclude by examining the ground cover, altitude and slope gradient of selected semi-natural and transformed open spaces. This involved creating an inventory of the identified and analysed (open) spaces in a geodatabase, which included characteristics like degree of infrastructural development/intensity of use, size, ground cover, slope gradient and altitude. The Swiss semi-natural open spaces are mainly covered by loose rock (35.3%), followed by rock (26.7%) and glaciers (12.7); the latter in particular are an indication of barren Alpine land. Because of their transport infrastructure development, forests in Switzerland are classified as transformed open spaces. The highest percentage (42.4%) of semi-natural open spaces in Switzerland is located at elevations between 2,500 and 3,000 m; another 32.7% is between 2,000 and 2,500 m. This, too, is an indication of barren Alpine land. In general, it can be said that spatial units with a higher degree of infrastructural development are likely to be closer to the lower

elevations in the valleys so that the distribution of spaces at the different altitude ranges is also reflected in the classified spatial types: up to an altitude of 1,500 m, the share of semi-natural open spaces is only 1.2%. In contrast, 42.4% of the transformed open spaces are at altitudes below 2,000 m. The trend for the slope is similar to that for the altitude. The semi-natural open spaces can be found mainly in terrain with high slope gradients (20–30°: 33.7%, 30–40°: 24.4%). Approximately one quarter of all semi-natural open space is in terrain with lower slope gradients (5–20%). In contrast, transformed open spaces can be found in both flat terrain (less than 15°: 27.5%) and in steep terrain (20–30°: 24.8%). This can be explained by the presence of mechanical lifts.

In summary, two kinds of open space can be distinguished. Firstly, there are (still) many untouched or semi-natural landscape areas in Switzerland that are steep and at high altitude and covered in rock, glaciers or forest. Because of this and its topography and climate, this barren Alpine land can only be developed with considerable extra technical and financial effort or is virtually incompatible with nature-friendly uses excepting mountain sports and winter tourism. However, intensively used landscape areas such as ski resorts can still emerge from precisely this barren Alpine land in the highest elevation ranges. Thus, even for these landscapes, development and the loss of their semi-natural character cannot be ruled out. Secondly, landscape areas can be identified that are strongly at risk from further anthropogenic transformation since they are already up to one-fifth developed. These landscapes are at a lower elevation range, flat, and characterised by loose rock. As a result, such spaces are in principle suitable for extensive spatial development and are thus very much at risk. These already transformed open spaces are at risk of losing their natural and open space character due to the addition of more infrastructure.

6.5 Synthesis of open space analyses

Having elucidated the methods used in the individual analyses for the identification and delimitation of open spaces in the German-speaking Alpine region in detail, they are systematically compared in this section using a number of indicators, and their commonalities and differences discussed. Firstly, an overview of the individual analyses of open space according to the selected indicators is presented as a table (cf. Table 9). It should be noted that there is a fundamental problem in comparing the analyses as the studies were conducted at different times, independently of one another, and had access to very different resources. As explained in Section 3, this is a synopsis of open space analyses of differing scope. Furthermore, the Salzburg study did not follow a traditional GIS-based approach.

	Alpine quiet areas – federal state of Salzburg	White zones – federal state of Vorarlberg	Undeveloped areas – South Tyrol	Semi-natural open spaces – Switzerland
Contracting authority / Initiative	Office of the Federal State Government of Salzburg	Federal State Government of Vorarlberg	Umbrella Association for Nature and Environmental Protection in South Tyrol (funded by the autonomous province of Bolzano / South Tyrol, Department for Nature and Landscape)	Swiss Federal Institute for Forest, Snow and Landscape Research *(Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft, WSL)* (Regional Economy and Development Research Group)
Edited by	Richard Schoßleitner – Office for Geography and Spatial Research	Manfred Kopf, Andreas Marlin, Stefan Obkircher – Department of Spatial Planning and Building Law (and Department of Climate Protection)	Kurt Kußtatscher, Ines Breitenberger – Trifolium	Marco Pütz, Christoph Knauf, Gero Nischik – Regional Economy and Development Research Group
Project start	unknown	2012	2009	2016
Research area (size)	• Austrian State of Salzburg • Size: 7,156 km²	• Austrian State of Vorarlberg • Size: 2,601 km²	• Autonomous province of Bolzano / South Tyrol • Size: 7,400 km²	• Swiss Alps (area in line with the Alpine Convention) • Size: 25,197.6 km²
Objectives	• Support the designation of Alpine quiet areas at local and regional level • Consultation for 2017 Federal State Development Programme revision	First phase: recording of untouched, semi-natural and little developed Alpine landscape areas Second phase: long-term safeguarding of these areas as white zones	Recording of undeveloped areas (residual landscape areas without fragmentation)	• Methodological operationalisation of the term/concept of open space • Identification and inventorisation of semi-natural open spaces in the Swiss Alps • Development of spatial types
Methodological approach for the stipulation of spatial units	Use of existing area designations	Hydrological modelling: 20,000 small catchment areas manually joined to form larger hydrological units (landscape units) (Grabher Environmental Office)	unknown	Hydrological modelling: 14,500 sub-catchment areas formed
Spatial unit used to assess the degree of infrastructural development	unknown	• Landscape units • Average size: 3.3 km² • Min. 0.27 km²; max. 25.5 km²	• No spatial unit in the narrow sense • = Entire territory of province	Hydrological sub-catchment areas
Database of infrastructures	SAGISonline	VoGIS of the state of Vorarlberg	• Geo-browser of the autonomous province of Bolzano / South Tyrol • Paths shapefile of the Office for Supra-Local Spatial Planning of the autonomous province of Bolzano / South Tyrol	• Infrastructures: TLM Switzerland • Elevation model: swissALTI3D • Basic geometry of Switzerland

Disruptive infrastructures	• Roads: national and federal state roads, roads of supra-local importance, municipal roads, private roads and tollways for public transport, large car parks > 1000 m^2 • Railways • Ski runs including mechanical lifts, lift stations, reservoirs, snow machines, food services and accommodation • Summer and winter toboggan tracks, leisure and amusement parks, motorsport facilities, shooting ranges, football and tennis facilities, downhill routes for mountain bikes • Large camping sites, hotels, resorts, holiday villages • Airfields • Hydropower plants > 15 MW bottleneck output, solar plants with over 200 m^2 collector surfaces, wind farms over 500 kW, biomass heating systems with at least 100 MW output, power lines, large transformer stations • Landfills, central sewage treatment plants, storage areas > 1000 m^2 • Hazardous areas according to shooting and explosives regulations, abandoned landfills and contaminated sites, mining areas • Restricted military areas and facilities	• State roads, local roads, motorways, forest and supply roads, private roads • Mechanical lifts and ski runs • Goods cable lifts • Reservoirs • Overhead electrical power lines • Address points and/or buildings of over 200 m^2 • Railway tracks • Building sites in the preparatory land-use plan (building site – core area, building site – housing area, building site – mixed use area, building site – commercial area)	• Settled areas • Motorway, national roads, state roads, municipal roads, cycling paths, forest and Alpine paths, supply paths, private streets, other road infrastructure and roads ‘under construction’ • Railways • Tourist infrastructure like ski runs, mechanical lifts and hiking trails only used for visualisation	• All buildings • Public car parks, private driving areas, private car parks, rest zones, public thoroughfares, motorways, entrance and exit slip roads, services, service entrances, roads, 10 m roads, 8 m roads, 6 m roads, 4 m roads, 3 m roads, squares, access roads, road links • Standard gauge railways, narrow gauge railways with standard gauge, light railways, narrow gauge railways, motorail trains • Gondola cableways, aerial cableways, chairlifts, ski lifts • Airfields, airports, aerodromes, heliports, grass runways, hard-surfaced runways, perrons, grass taxiways, hard-surfaced taxiways • Leisure centres, golf courses, racecourses • Swimming pools, sports grounds, bobsleigh runs, running tracks, toboggan runs, butts, ski jumps, sports grounds • Antennae, aerials • Trade show grounds, hospitals • Allotments • Schools, colleges • High-voltage lines, pressurised pipelines (single), pressurised pipelines (double) • Reservoirs, dams, weirs • Conveyors, facilities for gravel extraction, clay mining, quarrying • Wastewater treatment facilities, landfills • Wind turbines, hydropower facilities, wood-fired power plants, solar power plants, biomass power plants • Emplacements • Zoos

Table 9: Synthesis of open space analyses

Buffer around infrastructures	No buffer	Standard buffer of 200 m	Roads: standard buffer of 5 m	Differentiated into four buffer classes: 25 m, 200 m, 500 m and 1,000 m
Methodological basis for establishing the buffers	unknown	Established on grounds of plausibility	Disruption dependent on various factors so differentiation is impossible and a standard buffer used	• Differentiation into disruptive/non-disruptive • Various model run-throughs and verification • Basis: LABES population survey, noise propagation
Methodology for GIS operations	Excluded areas approach	• Calculation of the 200 m buffer to an entire polygon (= infrastructure buffer) • Combination of infrastructure buffers with the landscape units • Calculation of the proportion of each landscape unit occupied by the infrastructure buffer (= degree of infrastructural development)	• Calculation of the 5 m buffer • Residual areas (in the sense of non-fragmented) are combined as individual non-developed areas	• Allocation of the infrastructures to a buffer class • Calculation of four buffer classes with corresponding infrastructures (= differentiated impact area) • Individual buffer areas combined into an entire polygon • Obtain degree of infrastructural development by calculating the proportion of area
Identified open spaces (number, average size)	unknown	• 83 white zones • Average size 988 ha	• 487 areas • Average size 1,282.3 ha	• 415 semi-natural open spaces (minimum size 2 ha) • Average size 61.4 ha
Relationship of open spaces – research area	unknown	• A total of 800 km^2 of white zones were identified • Approx. 33% of state territory	• A total of 6,245 km^2 of undeveloped areas were identified • 84% of state territory	• A total of approx. 2,550 km^2 of semi-natural open spaces were identified • Approx. 10% of Swiss Alpine region
Spatial category/categories	• Excluded areas • Areas with potential Alpine quiet areas (also a planning category, cf. Section 6.3)	• Three categories of white zone: divided into core, buffer and development zones • 20% degree of infrastructural development in the core zone • Minimum size of buffer zone: 2 ha (in principle envisioned as a planning category, cf. Section 6.1)	• Undeveloped areas = residual areas without fragmentation situated between infrastructures • Minimum size: 100 ha • Divided into six size classes: 100–500 ha, 500–2,000 ha, 2,000–10,000 ha, 10,000–50,000 ha, 50,000–100,000 ha, 100,000–120,000 ha	• Classification into three spatial types • Spatial categories: semi-natural open space (infrastructural development 0% of disruptive infrastructure), transformed open space (0.1–20%), built-up space (>20%)

When there is a planning intention to preserve semi-natural open spaces in the long term and to implement this in spatial planning structures as a legal obligation, the body commissioning, implementing or conducting the analysis is of great significance. Thus the analysis for Vorarlberg was commissioned by the Vorarlberg state government and was conducted by a state agency, the department for spatial planning and building law. Such an approach can – if the political will to implement it is not lost – be hugely effective in later implementation, especially due to the political goodwill that can be expected. On the other hand, when the will of individual political stakeholders is the driving force of such initiatives, this can also have a negative influence on the course of the project.

A state-affiliated research institution such as the Swiss Federal Institute for Forest, Snow and Landscape Research enjoys advantages with regard to the availability of spatial data, contributes to the theory and methodology of the scientific and planning debate, and generally raises awareness of the issue. Moreover, it is not beholden to the authorities. As a consequence, however, it may lack (sectoral) policy backing for implementation. The study for South Tyrol was commissioned by an (umbrella) association, funded by the autonomous province of Bolzano – South Tyrol (governmental), and conducted by a private landscape planning firm. This was one of the reasons why the study was only intended for informational purposes from the beginning.

Conducting an open space analysis requires time, staffing and finances. If sufficient financial means are available then an external planning consultancy with specialised knowledge can conduct parts of the analysis, thus relieving pressure on internal staff and shortening the length of the project. Furthermore the level of knowledge is increased enormously by involving a larger circle of experts. It should be noted that more funding is often required for geodata. If those conducting the analysis are state employees, they will usually have better access to data but, as described above, they are also more subject to path dependency. To reiterate, the projects upon which this study is based differ significantly in terms of personnel, time and funding. In any case it is an advantage if those conducting the analysis are familiar with the area being studied.

It is obvious that the analyses of the open spaces were carried out at different times (between 2009 and 2017). The Swiss analysis of semi-natural open spaces was conducted after the studies in Vorarlberg and South Tyrol and drew some inspiration from these earlier studies in terms of preliminary considerations, procedure and execution. The ‘state of the art’ of knowledge and technology, current challenges, awareness of problems, and spatial planning approaches (especially political windows of opportunity) also depend on the timing of a study.

The research area in Vorarlberg is the smallest with an area of around 2,600 km². In comparison, the research areas for the Salzburg and South Tyrol studies, each around 7,300 km², are nearly three times as large. The research area in Switzerland is ten times as large. The size of the area analysed is less significant because, given appropriate data availability and computing capacity, the methodology can be applied to an area of any size. Nonetheless, a smaller research area makes findings

easier to verify and minimises the effort involved in defining spatial units or landscape units in the field. In addition, the probability is greater that a smaller research area will be more homogeneous. The more diverse a research area is, the better assumptions can be verified.

All the analyses synthesised here share the general objective of identifying undeveloped or semi-natural open spaces and safeguarding them in the long term. In the studies in Switzerland and Vorarlberg, the open spaces and white zones were methodologically operationalised using the degree of infrastructural development while taking into account the accessibility of the landscape areas and the ability to experience them through sustainable uses. The Salzburg study focused mainly on supporting the spatial planning implementation of Alpine quiet areas. In contrast, the analysis in South Tyrol concentrated on undeveloped areas that are completely free from disruptive infrastructure and are thus unfragmented and extremely valuable for flora and fauna.

Hydrological modelling was used to define the spatial units in Vorarlberg and Switzerland. The sub-catchment areas that were thus created acted as the spatial units for further steps of the analysis (e.g. calculation of the degree of infrastructural development). In addition, landscape units were developed in the Vorarlberg study by manually combining catchment areas. This allows perceptual spaces to be considered but is a very labour intensive procedure. For instance, it involved amalgamating about 20,000 small catchment areas to form 681 larger hydrological units, i.e. the landscape units. In this regard, the Swiss Alpine area is too large for this step of the analysis and therefore required more work.

The study in South Tyrol approached the object of research using the ecological function of open spaces. Here no spatial units were defined, rather the entire administrative area of the autonomous province was used as the spatial unit. The Salzburg study was based solely on existing territorial categories and approached the issue of open spaces through compatible or incompatible land uses. The latter define the exclusion zones. The remaining space is then the potential Alpine quiet areas. In Vorarlberg and in Switzerland the areas that were to be evaluated were defined prior to the analysis. In South Tyrol, in contrast, the open spaces or undeveloped areas were delimited only by the analysis itself (study of infrastructural development); the entire province served as the research area.

With reference to harmonising the methodological approaches to defining Alpine open spaces, it can be noted that the landscape units used in Vorarlberg can, for the purposes of this publication, be viewed as very sound spatial units for open space as they are based on natural spaces and can be perceived as landscapes. Due to a lack of capacity and its large research area, the independently conducted Swiss study was unable to define landscape units initially. Instead the sub-catchment areas were selected and later in the analysis were amalgamated into larger areas with a similar degree of infrastructural development. In the future the aim should be to pursue the methods used in Vorarlberg here.

The database on which the studies were based was compiled by state institutions. Consequently the body of data is very dependent on national or state-affiliated efforts at compilation. The quality of the data can, however, be decisive for the results of the analysis, e.g. for the choice of infrastructures and buffers. All the studies except the Salzburg analysis also implemented cartographic elevation models to enable conclusions to be drawn about the altitude and slope gradient of the open spaces. The various infrastructures taken into consideration as a result of the available data are primarily transport and settlement areas, although all the analyses also considered tourism and energy infrastructures. The Swiss analysis was able to differentiate very precisely between the different (technical) infrastructures, to define several buffer subcategories and also to distinguish between disruptive and non-disruptive infrastructure in terms of spatially relevant impact. All the analyses used buffers around infrastructures as a basic approach, except for the Salzburg study which omitted this owing to the legally anchored spatial planning focus on GIS analysis. The blanket buffering approach of the Vorarlberg study was based on the assumption that a 200 m buffer around each item of infrastructure methodologically combines the principle of preservation with recreation, experience and accessibility. The South Tyrol study used just a five-metre buffer around transport infrastructure with the justification that the disruptive impact of infrastructure depends on the surrounding landscape, the type of species affected and the amount of traffic, and that it is therefore not possible to capture their different disruptive impacts through the use of different buffers. In contrast, the Swiss analyses attempted to differentiate the disruptive impact of infrastructural developments using four buffer classes (25 m, 200 m, 500 m and 1,000 m) based on a survey of the inhabitants and noise propagation. This certainly seems most appropriate for future procedures given the importance of its impact on people.

The studies in Vorarlberg and Switzerland were based on the methodological approach of an overlay analysis of infrastructural areas already provided with buffers and spatial units (landscape units vs. sub-catchment areas). In Vorarlberg the buffer was calculated for each of the ten infrastructure datasets used, amalgamated into a single polygon, the infrastructure was combined with the landscape unit, and thus the degree of infrastructural development (proportion of the area of the infrastructure buffer in the spatial unit) was calculated. In the South Tyrol study the undeveloped area was identified by extracting the polygon area of the infrastructure, including a five-metre buffer, from the total area of South Tyrol. These are two fundamentally different approaches (degree of infrastructural development vs. extracted area). The Salzburg study took yet another approach: here, types of use were matched with existing territorial categories.

In the Vorarlberg study, 83 white zones with an area of 800 km² were identified, equivalent to 33% of the area of Vorarlberg (around 2,600 km²). In South Tyrol, 487 undeveloped areas covering 6,245 km² were identified, equivalent to 84% of South Tyrol's land area (around 7,400 km²). The latter result is linked to the choice of methodology, which in a sense results in a simplified 'woodcut' and makes the findings difficult to compare and somewhat controversial. This approach views open space from a primarily ecological perspective and thus does not directly consider anthro-

pogenic, semi-natural use. Furthermore the very low value selected for the buffers influences the results.

According to the definition used in Switzerland, 415 semi-natural open spaces with an area of 2,550 km² (10% of the Swiss Alps) were identified. The Swiss and South Tyrol studies map contiguous areas, while in contrast the Vorarlberg analysis presents isolated open spaces. All the analyses of open space derive their spatial categories from the open spaces identified. The Swiss study distinguished between open and built-up areas and divided the former into semi-natural (0% infrastructural development) and transformed open spaces (0.1–20% infrastructural development). The South Tyrol analysis divided the undeveloped areas into six size classes, while the Vorarlberg study subdivided the white zones into a core zone, a buffer zone and a development zone. The Salzburg study distinguished suitable areas and exclusion zones. These completely different spatial categories demonstrate the possible spectrum of differentiation of Alpine open spaces.

An outline of an ideal (methodological) approach (in the form of recommended actions) for GIS analyses with respect to identifying open spaces might look as follows:

> Use hydrological modelling to define spatial units, ideally amalgamating them into landscape units since landscape units approximate human spatial perceptions.

> Distinguish between disruptive and non-disruptive infrastructure; only buffer disruptive infrastructures, select different buffer classes (address subjective perception through surveys and include noise propagation).

> Verify buffers by comparison with current aerial photographs, in future with high-resolution aerial photographs in view of the newly launched European satellite system Galileo.

> Classify the identified spaces in order to enable more nuanced conclusions about the findings to be drawn, e.g. by spatial types or distinguishing between core and peripheral areas.

> Document the inventories, ideally with descriptive units (e.g. position, infrastructural development, geology, climate, flora and fauna, historical uses).

> Reduce the subjectivity of planning, for example with surveys on noise propagation and visual impressions.

> Adopt a cross-border analytical approach or include neighbouring areas across administrative boundaries while taking note of the problems of data harmonisation (same definition of infrastructure elements).

In summary it can be noted that the open space analyses presented here differ greatly. This is related to the methodologies chosen and to the differences between the projects in terms of the availability of resources. These resources are related to

the number of personnel, support from external specialists, financial and technical resources, and the available data. The availability of data through public channels is patchy in places or is associated with costs. The harmonisation of data, especially cross-border data, is very difficult. A state or state-affiliated institution of the Alpine countries, the EU or the Alpine Convention should set the goal of compiling and providing complete datasets for the entire Alpine region so that diverse analyses of open space can be carried out. Above all, this is important in order to be able to view and treat the Alpine region as a coherent space in its entirety.

7 Discussion, conclusions and desiderata

The overarching aim of this work is the long-term preservation of Alpine open spaces that are undeveloped or little impacted by infrastructural development while retaining their accessibility for the use and leisure of local residents and for tourists seeking recreation. Thus this study does not build on the traditional debates about wilderness (cf. *BMUB* [Federal Ministry for the Environment, Nature Conservation, Construction and Nuclear Safety] 2016; Bender/Roth/Job 2017); rather, it goes well beyond them by viewing the Alps as a historically evolved and regionally multifaceted cultural landscape whose traditional characteristics are worthy of preservation (Mayer/Kraus/Job 2011; Bätzing 2015a; Bätzing 2015b;) – including with respect to landscape-related tourism (Mayer/Woltering/Job 2008). In principle, the spatial planning debate and the use of planning instruments to safeguard open spaces, which are the main focus here, thus concern all high-altitude mountain areas. With regard to the status quo in the German-speaking Alpine region, we firstly provided an overview of established strategies for the preservation of open spaces – some of which appear at risk as of late – and of strategies intended for the future. Secondly, spatial planning approaches to the conservation of open spaces were synoptically summarised.

This publication contributes added value in that it does not build on the controversial debates about wilderness that are important to local users for acceptance reasons. On the contrary, it posits that it is urgently necessary to preserve minimally transformed and extensively used semi-natural landscapes as open spaces. From a spatial planning perspective, both the use of these spaces and their protection are in principle equally important. The motto for this work is thus not 'worthwild' but 'valuable landscapes' (cf. *BMUB* 2016; CIPRA Germany 2017). With respect to refuge areas for wild animals and ecological connectivity, large contiguous regions are called for in order to preserve biodiversity in the long term. This study also considers smaller areas (cf. Svadlenak-Gomez 2016). In addition to a new definition of open spaces and a comparison of the various open space analyses, our focus is on how spatial planning deals with semi-natural open spaces and on reactions to the current political situation in which neoliberal attitudes threaten to weaken proven instruments such as the Alpine Plan.

7.1 Classifying open space conservation approaches in planning paradigms

As explained in Chapter 2, according to Siebel (2006), spatial planning (Raumplanung) can be seen as having a dual nature: it possesses an objective side involving societal expectations and the de facto conditions in which it operates, and a subjective side involving the interpretations of these by different planners. Both aspects are subject to constant change, and planning paradigms change with them. In recent decades, the technical rationality that previously dominated spatial planning has been replaced by political and ecological rationality (Selle 1995; Siebel 2006). In the new millennium the new paradigms of sustainable rationality and planning resilience were discussed more widely (Sieverts 2012; Hammer/Mose/Siegrist et al. 2015). At the time when the first binding spatial planning approaches to the conservation of open spaces emerged

(e.g. Bavaria's Alpine Plan), a closed planning model prevailed that was based on the idea of a sovereign spatial planning body operating in a top-down fashion. This model is no longer a good fit with today's planning, which is based much more on moderation, mediation, consensus and community participation (top-down versus bottom-up approaches). An example of this is the exhaustive and controversial participation process involved in drawing up the white zones in Vorarlberg (cf. Section 6.2). Still, the strength and pervasiveness of the technical/rational planning paradigm continues to have an impact today, as demonstrated by the Bavarian Alpine Plan as a spatial planning instrument or the Tyrolean quiet areas as a sectoral planning standard for nature conservation (cf. Job/Mayer/Kraus 2014; cf. Section 5.2). Considering the advantages and disadvantages of the planning paradigms set forth by Siebel (2006) in relation to the existing approaches to open space conservation in the Alps, it can be seen that the approaches taken by the Bavarian Alpine Plan and the Tyrolean quiet areas, which were drawn up and took effect in the 1970s, were very much a part of that era's trend towards comprehensive development planning. However, according to Siebel (2006: 14), the closed planning model is 'inappropriate in social and political situations'. This is reflected in the current Riedberger Horn conflict, where the validity and thus the effectiveness of the Alpine Plan ultimately depends on the political will of policymakers. On the other hand, it would be difficult to pursue the open planning model effectively in Alpine open space conservation due to the skewed power structure, the opposing interests of the stakeholders and because such cases are about ecology and preserving a healthy environment for future generations, and involve fraught conflicts over land use. Siebel (2006) views the open planning model as unsuitable for all of these aspects. Neither can an ecological planning rationality be brought to bear as the encroachments on the environment that the conservation of open spaces seeks to prevent are usually at best only partly reversible (depending on altitude, time scale and environmental norms). All in all, the two implemented spatial planning approaches described here for the conservation of Alpine open spaces can be seen as prime examples of the largely successful use of the closed planning model.

7.2 Assessment of superordinate frameworks in the context of open space conservation

A considerable amount of cross-border cooperation can be seen throughout the Alps today. The primary focus has traditionally been on the EU's bi- and trilateral INTERREG A programmes, Euroregions[19] and the transnational Alpine Space programme supported by INTERREG B. Now, at a somewhat larger scale, the macro-regional strategies have been added, including EUSALP for the Alpine region. This strategy applies across an even larger territory than INTERREG B and has thus far shown no institutional connection with spatial planning in the Alpine states or with the 25-year-old Alpine Convention.

19 For example, along the border of Bavaria, Austria and Switzerland: the International Lake Constance Conference, the West Steering Committee with Via Salina and Zugspitze, and the Central Steering Committee with Inntal and Salzburg.

The aim of this new idea for territorial cooperation is to address cross-border challenges in spaces with 'shared geographical particularities'. However, dedicated funding or a specific set of instruments have not been settled (Bätzing 2015a: 368 et seq.). The EUSALP core region is characterised by at least five geographic particularities: naturally pronounced relative relief and young high-altitude morphology, an extremely high degree of natural and cultural (bio)diversity, the great importance of its resources (Europe's water reservoir), its immense significance as a source of recreation and tourism for local residents and visitors, and the density of its international borders. The latter always mark differences in legal practice as well. It should be borne in mind here that the preservation of open spaces through spatial planning, while difficult at the national level, is an even more complex policy area in a cross-border context: whilst functional spatial interactions across borders (commuter flows, holiday and retirement homes, visitor traffic) are steadily increasing, political authority remains clearly organised by territory. This is particularly true of the authority for spatial and conservation planning in the federally organised states in our research area, the German-speaking Alpine region.

Overall, the dedication that politicians at the national, regional, cantonal and municipal level have shown in the implementation of EUSALP within a short time is remarkable – all the more so given that this strategy has neither legal authority nor funding. The exploitation of available funds at different levels, the reduction of regional and national disparities and the creation of synergies for growth and employment have been the drivers of the rapid implementation of the new strategy for the Alpine region. The Alpine Convention, which has access to functioning structures and networks and is also anchored in international law, has yet to benefit from this political engagement, although its protocols, declarations and action plans are aimed at the sustainable development and protection of the Alpine region. There are working groups and platforms under the Alpine Convention's umbrella that address the details of specific Alpine issues that would have to be worked out with great effort in the EUSALP process or might even be neglected completely. The Alpine Convention's protocol relating to spatial planning and sustainable development could serve in the EUSALP process as a basis for discussion and for the development of a spatial planning strategy for the entire Alpine region. In the years ahead, it will most likely be up to the inhabitants of the Alps to contribute ideas and proposals – especially from the Alpine Convention's work – and to use this as an opportunity to create added value. Otherwise it is to be feared that the Alpine region, and with it the Alpine Convention, will merely play the role of an extra in the macro-regional strategy for the Alpine region (Haßlacher 2013: 9).

Critics of the EUSALP process fear that this would mean that the Alpine Convention, which has been recognised as international law and as a milestone of comprehensive Alpine policy for 25 years and which in its protocols places a strong emphasis on environmental considerations and thus on the natural foundations of life (cf. Section 4.1), could rapidly lose significance (cf. Bätzing 2014; Erlacher 2014; Haßlacher 2016e). Instead, the metropolises in the Alpine lowlands and the densely populated main Alpine valleys and their business interests could make lopsided gains in importance, with the conservation of open spaces falling by the wayside (cf. the neoliberal perspective in Bätzing 2015b). The Alpine Convention is neither an environmental

protection panacea nor a paper tiger (cf. critics of the Alpine Convention such as Ruppert 2004). It enhances national legislation by providing targets and forces decisions to be based on a weighing of interests (Schmid 2016). It is not a Magna Carta for the Alpine region but is still too valuable to be permitted to fade into obscurity. Bätzing (2016: 35) thus correctly summarises: 'If there were no Alpine Convention, it would in fact have to be reinvented. But given the present political situation, that would hardly be possible today.'

7.3 Assessment of existing spatial planning approaches to the conservation of open spaces in the Alps

7.3.1 Assessment of the Bavarian Alpine Plan

Implemented in 1972, the Bavarian Alpine Plan is probably the most important and comprehensive planning instrument for open space conservation in the Alps because it covers the entire Bavarian Alpine region and divides the landscape into zones of different intensity of use. Table 10 lists the strengths and weaknesses of the Alpine Plan.

Since the initial formulation of Bavaria's State Development Programme in 1976, the Alpine Plan has been the instrument with the greatest continuity, it also remained unchanged during the reform in 2013. This is astounding since the Federal State Development Programme otherwise bears rather neoliberal hallmarks and because the Alpine Plan embodies a spatial planning objective that strictly observes the principle of priority so that there is no discretionary scope for deviations from spatial planning requirements at the land parcel level (cf. Job/Fröhlich/Geiger et al. 2013). In addition, the Alpine Plan is the only part of the 2013 Federal State Development Programme in which tourism is seriously discussed under the paradigm of sustainability. In contrast to the diverse strategy papers on sustainable tourism at the international level and on superordinate frameworks for the Alpine region (cf. Section 7.2), the Alpine Plan, like the Tyrolean quiet areas, assumes explicit responsibility for the areas in question (Job/Mayer/Kraus 2014).

Strengths	Weaknesses
Spatial planning instrument with consistent status as an objective in the Federal State Development Programme and strong legal impact to this day (two minor revisions led to only marginal expansion of Zone C)	Concentration of Zone C on barren Alpine lands ('worthless land' hypothesis), underrepresented at lower elevations
In a sense, Zone C functions as an additional strict land conservation category in spaces without conservation areas	Ski tourism is intensifying through qualitative expansion of the infrastructure, but thus far only at existing locations
Implementation long before the global sustainability paradigm from Rio arose	No effect on the trend towards individualisation in landscape-based leisure sports (e.g. e-bikes)
Effective protection of Bavarian Alps against overdevelopment of ski tourism infrastructure	Fragmentation of Zone C with forest and Alpine paths increasing which is not affected by Alpine Plan
No negative impact on tourism	Largely unknown outside of specialist circles, for example compared with national parks

Table 10: Strengths and weaknesses of the Bavarian Alpine Plan / Source: The authors, based on Job/Mayer/Kraus (2014)

The Alpine Plan is by no means perfect; it does have its weak points. For example, it has a cumbersome official title (*Teilprogramm 'Erholungsraum Alpen' des Landesentwicklungsprogramms* [sub-programme of the Federal State Development Programme] or *Teilabschnitt Erholungslandschaft Alpen des Bayerischen Landesentwicklungs-programms* [subsection of the Bavarian Federal State Development Programme on the Alpine recreational landscape]) and is thus virtually unknown to the general public. One should consider how much greater the indignation on the part of the critical public would be if, in the case of the Riedberger Horn, an effort were to be undertaken to abolish a national park (cf. the Vanoise affair in France in 1969–1971; Laslaz 2004; Mayer/Mose 2017).[20]

7.3.2 Assessment of the Tyrolean quiet areas

The Tyrolean quiet areas are a stable spatial planning element in Tyrol for the long-term protection of Alpine open spaces against large-scale infrastructure development such as mechanical lifts, ski runs and roads. Following the designation of eight quiet areas between 1981 and 2000, this spatial planning and protection strategy has faltered as it became Tyrolean state government policy not to take responsibility for protected areas covering more than 25% of the land area (in January 2017: 25.3%; Fischler 2017: 19). Other, earlier quiet area plans were also drawn up, in particular by the Austrian Alpine Association's department for spatial planning and nature conservation; these included Wildseeloder-Geißstein, Wilde Krimml and Märzen-

20 Most senior representatives of the large and globally influential nature conservation organisations such as the WWF or Greenpeace, which are otherwise staunch backers of any effort to designate national parks, are not even aware of this important conservation and spatial planning instrument.

grund in the Kitzbühel Alps, the Tux Alps, Gilfert-Rastkogel, the Rofan Group, the Samnaun Alps, the eastern Silvretta Alps, the Verwall Group, the Lechtal Alps and the northern Mieming Range. However, no politically opportune time frame arose for their realisation, although the process had made significant progress in some cases. The implementation of further quiet areas will in future probably only be possible in parallel with the approval of ski resort expansions as part of offsetting schemes for impact mitigation.

In this regard, it should be noted that Tyrol needs a network of quiet areas that is regionally balanced and equitably distributed from a spatial structure perspective and that represents the diversity of (cultural) landscapes in Tyrol. Thus far the Landeck and Kufstein/Kitzbühel districts are still 'blank areas' on the map of Tyrolean quiet areas (cf. Fig. 4) and are generally underrepresented as far as conservation areas are concerned (Mayer/Kraus/Job 2011). To this end, cooperation between spatial planning and nature conservation authorities needs to be strengthened.

7.4 Assessment of spatial planning approaches to open space conservation currently in development

Politicians in the parliament of the Austrian federal state of Salzburg agreed to adopt an amendment on Alpine quiet areas before summer 2017. Its implementation with respect to planning will occur in the pending revision of Salzburg's Federal State Development Programme following adoption of the reform. To that end, a study was officially commissioned to define Alpine quiet areas in Salzburg's spatial planning with the aim of drawing up an implementation proposal for the delineation of such areas at the regional and local planning level using existing area designations. This study shows a clear link to spatial planning practice. To make it clear that Alpine quiet areas are not 'exclusion zones', the definition was performed for both compatible uses ('positive access') and incompatible uses ('negative access') (Schoßleitner 2016: 12). From a planning perspective, Alpine quiet areas thus usually begin where green space designations (green corridors, green belts) specific to spatial planning end (Schoßleitner 2016: 5). The designation of Alpine quiet areas can close gaps and protect previously unprotected regions (Schoßleitner 2016: 6) by assigning priority to open space conservation. The description of the compatible and incompatible uses turns out to be extremely comprehensive, but 'the description of the options and limits of use in Alpine quiet areas makes no claim to be exhaustive' (Schoßleitner 2016: 12). However, in order to 'avoid overloading planning maps' at the state level, 'only selected (large) exclusion zones are used, such as ski resorts, supra-local public thoroughfares and sites for the surface extraction of raw materials' (Schoßleitner 2016: 49). The study thus serves 'primarily to estimate the spatial extent of Alpine quiet areas in the federal state of Salzburg' (Schoßleitner 2016: 49). In order to restrict intensive uses in Alpine quiet areas, the future use of discretely defined buffer zones of various sizes is conceivable to avoid indirect stresses. These buffer zones could be defined based on the emissions caused by activities in an area (with noise-induced stress as one of the most important negative impacts), analogously to the analytical method applied in Switzerland. Linear objects would then become swathes (cf. Schoßleitner 2016: 47).

The white zones in Vorarlberg currently represent an inventory without binding character from a spatial planning perspective. However, a commitment to the establishment of white zones is anchored in Vorarlberg's 2020 tourism strategy and in the Vorarlberg state government's work programme for 2014–2019. Currently there are plans to publish a white zone inventory before the end of 2017. It will not be legally binding from a spatial planning perspective but will provide an important basis for expert reports by specialists.

Analogously to the other approaches based on GIS analyses (e.g. in Switzerland), the South Tyrol approach identifies the remaining large open spaces along the main Alpine crest in the southern Ötztal and Zillertal Alps and the High Tauern, which are in part protected by nature parks (e.g. Rieserferner-Ahrn Nature Park). There are also substantial open spaces outside the main crest in high Alpine massifs such as the Ortler Group and the Dolomites. However, the South Tyrol study found a much higher percentage of open space than the other studies because it chose a very small infrastructure buffer of only five metres. Moreover, numerous ski resorts with their associated environmental encroachments are within the open spaces identified (e.g. Sulden, Schnalstal glacier). That reduces the usefulness of the findings and could lead to the mistaken political conclusion that Alpine open spaces are not a rare and precious asset.

The proposals drawn up for the identification of open spaces in Switzerland currently only have the character of expert reports by scientists. They are not binding from a spatial planning perspective; rather, they represent the interim results of an ongoing research project.

During preparations for the GIS analysis, the cantonal planning staff in Graubünden and Uri were interviewed in a preliminary study. These cantons were chosen because a direct comparison shows them to be very different, though both have a large share of Alpine land and are thus quite accustomed to dealing with the issue of semi-natural open spaces. In addition, an expert from the Swiss association for spatial planning (*Schweizerische Vereinigung für Landesplanung, VLP-ASPAN*) was interviewed since this association unites spatial planners from all cantons and has an overall perspective on the entire country, particularly as regards legal questions relating to spatial planning. These interviews were conducted using a semi-standardised guideline that essentially covered the following topics:

> definition of 'open space' and delineation criteria;

> assessment of the current situation and the need for open space conservation;

> spatial planning instruments, implementation, actors, obstacles;

> roles of agriculture and tourism and competing uses;

> cross-border cooperation;

> the need to inform in matters relating to open space conservation.

Expert perspective on how the spatial planning authorities approach open spaces in Switzerland

What follows is a very brief overview of the obstacles confronting open space planning as identified by experts and an equally brief indication of how they might be overcome in order to safeguard semi-natural open spaces in the Swiss Alps.

Obstacles to open space planning from the experts' perspective:

> strong lobby (especially agriculture);
> Swiss government leaves spatial planning *(Raumplanung)* to the cantons but the distribution of responsibilities is complicated;
> descriptive units in the federal inventory of landscapes and natural monuments *(Bundesinventar der Landschaften und Naturdenkmäler, BLN)* lack detail;
> economic support for peripheral areas to ensure equal opportunities is problematic;
> energy production is a competing use;
> the audits of cantonal development plans by the Swiss Federal Office for Spatial Development *(Bundesamt für Raumentwicklung, ARE)* are too lax;
> the distinction between building and non-building zones is an obsolete concept – a new planning culture is needed;
> the issue of open space conservation scarcely appears on spatial planning agendas.

Potential means to overcome open space planning challenges from the experts' perspective:

> more advice for municipalities;
> stronger stipulations in cantonal development plans;
> more precise definition of open space as a function (like the 'housing' function, for example);
> using the regional development plan as an instrument (as in Zurich);
> enhancement of the federal inventory of landscapes and natural monuments, especially specific descriptions and definitions;
> designation of regional nature parks;
> a landscape development strategy at municipality or canton level;
> further reform of spatial planning law beyond the evaluation of building zones that is currently underway (very uncertain);
> obligatory expert reports by the Federal Commission for the Protection of Nature and Cultural Heritage *(Eidgenössische Natur- und Heimatschutzkommission, ENHK)* (carries substantial weight but is mainly focused on aesthetics);
> raise awareness and provide more information about the conservation of open spaces.

7.5 Summary: the status of open space conservation in the German-speaking Alpine countries

Regrettably, in the entire Alpine region no other binding spatial planning scheme comparable to the Bavarian Alpine Plan and the Tyrolean quiet areas has been implemented.[21] Apparently there is a lack of awareness among decision makers that semi-natural open spaces are not perpetuated by chance and do not maintain themselves (Baier/Erdmann/Holz et al. 2006: 8). The pressure from competing uses is too strong and is becoming ever stronger. The consideration of nature and open space conservation in national sectoral legislation is usually rather symbolic in character and is seen as one public interest among many. Thus, what Baier/Czybulka/Erdmann et al. (2006: 566) correctly stated more than ten years ago continues to apply today: 'The public awareness of open space as an ecologically and socially valuable asset is just as lacking as an associated political, legislative and executive strategy for its preservation and development.'Thus, a better understanding of spatial and functional organisation based on land uses of differing intensities is required. Stronger safeguarding of open spaces through spatial planning is required to provide conservation areas for people and nature. A new spatial planning architecture that clearly defines areas for utilisation is also required (Haßlacher 2016c; Mayer/Strubelt/Kraus et al. 2016).

In any case, it can be seen that there are as yet no harmonised cross-border approaches to the preservation of open spaces for the German-speaking Alpine region. There are a number of reasons for this:

> the difficult situation and pressure on land use and the resulting friction in the 1960s and 1970s with very different initial situations in the individual nation states (Ruppert 2004);

> clear linguistic, cultural and mental divides in the Alps and distinct sectoral responsibilities in terms of policy (Bätzing 2014);

> the different regulation of spatial planning powers and of the legal framework for sectoral planning for nature conservation in the different nation states (the problem of federalism; cf. Bätzing 2015);

> the differing significance of the Alpine Convention between the territorial states and the fact that it is not binding in terms of implementation (cf. Section 4.1);

> problems associated with government policy in terms of regulations, funding policy and EU Cohesion Fund subsidies, e.g. in South Tyrol where mountain railways are often replaced after just 20 years (because this is more economically viable than technically complex upgrades) and the at times unnecessary construction of service roads for pastureland and forestry in Bavaria, where for instance in Oberallgäu there are subsidies of up to 90% (Mayer/Strubelt/Kraus et al. 2016).

21 It appears that the federal state of Salzburg will soon follow with the reform of the Federal State Development Programme that is currently in progress.

A look at the current Bavarian State Development Programme reveals few statements about regional planning that go beyond national borders. For example, it stipulates that the 'cross-border central places defined with Austria [...] [should] particularly advance cross-border development and cooperation' (point 5b et seq., no. 2.1.10 G in the draft revision of the Bavarian State Development Programme of 12 July 2016), referring to five axes. The older regulation 5.3.5, pushed by the Salzburg higher-order centre (large centre) out of fears of lost purchasing power, facilitates procedures for derogating from spatial planning objectives in border regions to remain competitive on the German side. Owing to winter tourism competition from Austria[22], there have recently been efforts to weaken the Alpine Plan, which has proven itself as a steering instrument for regional planning (cf. Section 5.1). This has involved a reversal of the fundamental spatial planning perspective whereby the strategic and proactive coordination of contradictory spatial functions leads to an avoidance of conflict, in this case since 1972, successfully impeding the spiral of tourism expansion driven by municipal competition without hindering tourism (contrary to municipal investment competition).[23] Such statements thwart the conservation of open spaces and weaken the potential of federal state spatial planning in terms of hard, long-term instruments. For issues like tourism and conservation areas that are central to the Alpine region and its foothills, considerably greater farsightedness would seem called for, especially in a Europe of regions.

The conservation of open spaces in the Alps is relevant for the protection of natural heritage (biodiversity), the preservation of landscape aesthetics, the safeguarding of the ecosystem services that these areas provide, and the provision of classic landscape-related recreation. This must be guaranteed without unnecessarily restricting the economy and transport, because the Alps need to be preserved as a place where the local population lives and works. In this context it is imperative that open spaces are designated strategically and that the associated planning instruments are implemented in spatial planning. The spatial planning institutions should fulfil their present-day role of coordinating conflicting land-use functions in the Alpine region.

22 The justification for the draft revision of the Bavarian State Development Programme regarding zoning in the Alpine Plan (7 February 2017) states: 'For example, Austria currently has cable cars with more than 2,900 lift facilities' and thus many times more than in the (much smaller) Alpine part of Bavaria.

23 There is nothing new about the plans to develop the Riedberger Horn. There have been multiple efforts to expand the facilities in question, the previous effort being in 2010. However, they have been rejected in every Alpine Plan revision from 1972 through 2013 and the area in question has always been left in Zone C. This case once again demonstrates an inherent risk related to infrastructural development in the Alps: cable car operators can make repeated attempts to push their plans through. If spatial planning fails even once, then yet another landscape unit will be lost to an Alpine ski resort (Haßlacher 2006: 100).

7.6 Desiderata

The key results and the future challenges and recommended actions derived from our analyses are as follows:

> Harmonisation of the data used for GIS analyses of spatial structures is urgently needed throughout the Alps.

> A general update of the Alpine Plan in Bavaria is essential, but not one that is based on the politically driven debate now taking place about Germany's currently most prominent mountain or one that would arbitrarily shift zonal allocations. Such an update should incorporate state-of-the-art GIS analyses, biotope and geohazard mapping, etc.[24] Furthermore, a spatial expansion of the Alpine Plan is needed, with emphasis on more than the Alpine region in the narrow sense (101 municipalities); it should include the entire area of all Alpine districts in Bavaria (scope of Alpine Convention), as they are suffering from extreme population and land-use pressure (cf. Mayer/Job 2014). Hence, a regulated area is needed with priority areas for sustainable development of the settlement structure (on public transport axes), as are landscape priority areas for groundwater protection, soil conservation and biotope protection (*ARL* 2016: 2). Clearly there can be no revision of the Federal State Development Programme that weakens the Alpine Plan with a first-time encroachment on Zone C. Furthermore, in the future every Zone C should be surrounded by a Zone B to provide a buffer function, and the C zones should always be less fragmented than the B zones (by pasture and forest roads).

> The designation of additional quiet areas is urgently needed in order to compensate for the numerous new installations of mechanical lifts to connect ski resorts in Tyrol in recent years. In addition, existing quiet areas may not be directly or indirectly impacted by development projects.

> For Salzburg, Vorarlberg, South Tyrol and Switzerland, it would be desirable for existing and planned approaches to open space conservation to be implemented in spatial planning. To this end and for reasons of ecological connectivity, when setting aside semi-natural recreation areas near settlements it would be advisable to give greater consideration than was the case with previous designations to the lower altitudes and valley areas that in many cases are already highly developed, so that Alpine open spaces are not limited – analogously to the Alpine national parks (cf. Mayer/Mose 2017) – to high-altitude 'worthless lands' that are economically unattractive in any case. Of course the same desideratum applies to the Bavarian Alpine Plan and the Tyrolean quiet areas.

> Renewable energy development in the Alps (cf. Bätzing 2015b, 'downstream inhabitant perspective' scenario) – or the additional reservoirs to be built for the generation, conversion and storage of energy or for storing drinking and process water in efforts related to the energy transition and/or because of the potential

24 This also applies for the zone nomenclature and its colour selection, which needs to be designed according to the established traffic light system.

increase in summer water shortages in the foothills – will predictably have an increased impact on remaining Alpine open spaces (Kraxner/Leduc/León et al. 2016: 93).

> The same danger is also posed by the potential that various global warming scenarios could come to pass in the decades ahead; their effects could threaten the survival of some businesses in the ski tourism sector. This in turn could revive and reinvigorate the push to develop previously protected high-altitude areas and the remaining glaciers that could still be exploited for skiing. There is no shortage of unrealised past projects of this sort (cf. Mayer/Mose 2017).

> Problems relating to open space conservation are not restricted to the highest altitudes of the Alps; they are also present in medium and lower altitudes as well as in the valleys (e.g. second-home issues), where they are sometimes even more serious. This situation calls for more in-depth research on open spaces in valley zones (cf. Wüstemann 2017).

> The identification and verification of the remaining open spaces according to a uniform definition and analytical method is a must.

> The Alpine Convention and especially the spatial planning protocol must again be given their rightful place on the policy agenda of the Alpine states. The Alpine Convention is better suited to achieving sustainable development of the Alps as a whole than the EUSALP strategy. This requirement for cross-border coordination and cooperation in spatial planning and in sectoral planning for nature conservation is also underscored by Plassmann, who argues that Alpine countries must coordinate and harmonise their approaches to nature conservation policy and measures across the entire Alpine arch, as cohesion is needed to ensure the quality and impact of such efforts (Plassmann 2016: 32). But Alpine open spaces can only be conserved at the local level if acceptance of spatial planning stipulations can also be achieved among the populace of the affected valleys through participatory communication processes (cf. Plassmann 2016: 32).

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ABSTRACT

Analysing, assessing and safeguarding Alpine open spaces through spatial planning

Alpine open spaces are becoming noticeably scarcer. In the Alps, this applies to the inherently limited area of permanent settlement, which in the case of Tyrol covers only 11.8%. The population is growing in many of the valleys and with it the infrastructure it requires. However, the open spaces at higher altitudes are also being successively fragmented and equipped with infrastructure (e.g. cable cars, hydro-electric plants) or subjected to increasingly intensive use (e.g. with electric mountain bikes). The preservation of open spaces in the Alps began in Bavaria as early as 1972 with the implementation of the Alpine Plan, which established spatial planning objectives. The Alpine Plan divided Bavaria's Alpine region into three zones of varying traffic intensity, a true legislative innovation. Zone C was intended for nature conservation, which was still in its infancy at that time, and also aimed to reduce natural Alpine hazards. Primarily, however, this planning initiative was related to the role of the landscape as a setting for recreation in open spaces, i.e. leisure and tourism activities in natural surroundings. Today, there are similar, more or less successful initiatives in all of the German-speaking Alpine states and Switzerland. This publication aims to analyse, compare and describe these initiatives and to critically assess how they are formulated, how they work, and how they are implemented by planners. As the preservation of open spaces is a transnational issue, especially in the Alps, which are intersected by many political borders, we also address the framework provisions of the internationally binding Alpine Convention of 1991 and examine the new EU initiative EUSALP and its potential impact. The focus here, however, is on bringing together approaches for preserving open space for people (local inhabitants and their traditional economic activities, but also visitors) and their natural heritage. We present and critically evaluate present-day spatial planning practices related to Alpine open spaces in the German-speaking Alpine region and in Switzerland, and discuss future options for harmonising approaches across borders.

Keywords

Alpine open spaces – GIS analysis – open space analysis – nature conservation – spatial planning – tourism

Alpine open spaces are becoming noticeably scarcer. In the Alps, this applies to the inherently limited area of permanent settlement, which in the case of Tyrol covers only 11.8%. The population is growing in many of the valleys and with it the infrastructure it requires. However, the open spaces at higher altitudes are also being successively fragmented and equipped with infrastructure (e.g. cable cars, hydro-electric plants) or subjected to increasingly intensive use (e.g. with electric mountain bikes). The preservation of open spaces in the Alps began in Bavaria as early as 1972 with the implementation of the Alpine Plan, which established spatial planning objec-tives. The Alpine Plan divided Bavaria's Alpine region into three zones of varying traffic intensity, a true legislative innovation. Zone C was intended for nature conservation, which was still in its infancy at that time, and also aimed to reduce natural Alpine hazards. Primarily, however, this planning initiative was related to the role of the landscape as a setting for recreation in open spaces, i.e. leisure and tourism activities in natural surroundings. Today, there are similar, more or less successful initiatives in all of the German-speaking Alpine states and Switzerland. This publication aims to analyse, compare and describe these initiatives and to critically assess how they are formulated, how they work, and how they are implemented by planners. As the preservation of open spaces is a transnational issue, especially in the Alps, which are intersected by many political borders, we also address the framework provisions of the internationally binding Alpine Convention of 1991 and examine the new EU initiative EUSALP and its potential impact. The focus here, however, is on bringing together approaches for preserving open space for people (local inhabitants and their traditional economic activities, but also visitors) and their natural heritage. We present and critically evaluate present-day spatial planning practices related to Alpine open spaces in the German-speaking Alpine region and in Switzerland, and discuss future options for harmonising approaches across borders.

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ISBN 978-3-88838-107-2 (PDF version) · ISBN 978-3-88838-108-9 (print version)

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