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# Gries am Brenner/Vals Pilot Action Region: The Tyrolean Ski Tour Steering Concept - A Contribution to the Protection of Wildlife and Object Protective Forests

*Matthias Plörer and Dieter Stöhr*

## Abstract

When people engage in recreational activities in sensitive forest habitats, there can be unintended negative impacts on wildlife and forests. These include disturbance and displacement of wild game as well as damage to young plants (tree seedlings and saplings from ski or snowshoe compaction or direct physical damage from ski edges). These are just a few examples that highlight the need to manage the impact of recreationists with different measures in order to minimize the disturbance of game (especially red deer and roe deer) and the impairment of important object protective forests that this in turn causes. In Section 2 of this chapter, we describe the tourism, population, settlement area, economy, forestry and natural hazards in the GreenRisk4Alps Pilot Action Region (PAR) of Gries am Brenner and Vals in Tyrol, Austria. Section 3 provides an overview of the overarching initiative and integration forum, "Tyrolian mountains – experience together", which was initiated by the Amt der Tiroler Landesregierung (Office of the Tyrolean Provincial Government). We then provide a description of the exact workflow, the possible measures and other details on ski tour steering options. Ski tour steering measures in the Gries am Brenner and Vals PAR can be found in Section 3.4, followed by a critical review of the experiences in Section 4.

**Keywords:** protective forest, red deer, ski touring, natural hazards, recreation

## 1. Introduction

With the expansion of settlement and industrial areas, and the space-intensive development of infrastructure in the Austrian Alpine region, the importance of forests as an efficient protection measure against natural hazards has increased over the last hundred years [1]. Necessary management strategies to maintain the protective capacity of these forests must include silvicultural adaptation concepts which also address climate change. The challenges in the face of climate and socio-economic change are considerable. In addition to the influence of climate change,

wildlife management and tourism are among the factors that make it difficult for forest managers to maintain the protective functions and effects of forests against natural hazards [1].

In this chapter, we focus on one of our six GreenRisk4Alps pilot action regions, which is represented by the two municipalities of Gries am Brenner and Vals in the Tyrolean Wipptal Valley. This area is subject to numerous natural hazards, such as rockfall and snow avalanches, which endanger residents as well as visitors and key infrastructure. Therefore, it is essential that the surrounding protective forests and their protective effects are managed sustainably and as a priority.

The maintenance and improvement of the protective effects of these forests as a necessary integral part of modern risk management can be achieved through a combination of diverse interventions, management methods and strategies. In this best-practice example, we highlight how the steering of winter recreation activities such as ski touring, snow shoeing and off-piste skiing in combination with wildlife management can play a central role in protective forest management. We demonstrate how targeted visitor management with a variety of cost-effective measures can contribute to the preservation of the protective effect of forests against natural hazards.

## 2. Description of the Gries am Brenner and Vals PAR, Tyrol, Austria

### 2.1 General

The municipalities of Gries am Brenner and Vals are located in the Wipptal Valley in the southern part of the Austrian Federal Province of Tyrol, adjacent to the Italian border on the main ridge of the Alps (**Figure 1**). The two municipalities span an area of approximately 105 km². Only 10 km², i.e. 10% of the total area, are permanent settlement areas, and about 35% of the total area is forested. The remaining areas of the municipalities constitute agricultural land, water bodies, future construction areas, gardens and high alpine areas covered with pastures, alpine meadows or scree and rocks (30%) [2, 3].



**Figure 1.**
*Protected areas in the PAR. Source shapefiles: Land Tirol – Department Geoinformation. Aerial image: Google satellite.*

## 2.2 Population and settlements

The region of Gries am Brenner and Vals is home to 1,882 inhabitants (as of 2019), and the population growth is relatively slow compared to that of the entire region of Tyrol [4, 5]. In 2020, there were 671 registered buildings [6, 7]. Compared to other regions in the state of Tyrol, this region is not particularly densely populated.

## 2.3 Economy and tourism

The two municipalities of Gries am Brenner and Vals are quite different. Vals has only 28 businesses (excluding agriculture), while Gries am Brenner has 73 [8, 9]. This is due, among other things, to its location: the Valsertal is a side valley of the Wipptal Valley, while Gries am Brenner is located in its middle at the Brenner Pass, which is an important international transit route. From a tourism perspective, the Valsertal is less important compared to the municipality Gries am Brenner. While 43,789 overnight stays were recorded in Gries am Brenner in 2019, only 12,786 were recorded in the municipality of Vals [10, 11]. Based on these numbers, this destination region represents only a small share in Tyrol's tourism economy.

Winter tourism infrastructure such as ski areas (lifts, lodges, built ski trails), which attract large numbers of tourists to the region of Tyrol, are de facto absent in the PAR. One small ski area formerly located on Sattelberg Mountain is no longer in operation. However, parts of the municipality of Gries am Brenner and the Valsertal have become quite popular for ski touring and snowshoeing, which led to the initiation of the best-practice example described in Section 3.

## 2.4 Protected areas

Two protected landscapes provide large areas for sensitive plants and animals within the region, "Nösslachjoch-Obernberger See-Tribulaune" in the municipality of Gries am Brenner and a "Natura2000 Fauna-Flora-Habitat" area in the municipality of Vals (**Figure 1**).

## 2.5 Dealing with natural hazards

Transportation corridors and settlements are partly located at the base of steep rock faces. The region lies in the continental central alpine climate zone, which is characterized by wide temperature ranges and low precipitation with a pronounced summer maximum. A regional feature is the "Föhn" wind, a dry downdraft wind that can reach hurricane-like speeds. The mean annual precipitation for the period 1981–2010 was 817 mm [12]. This corresponds to a significantly below-average value compared to all other stations in Austria (mean maximum annual precipitation = 2,403 mm).

Overall, all notable alpine natural hazards occur in this PAR. Large areas of the municipality of Gries am Brenner are prone to shallow soil slides, and several torrents from various side valleys have the potential to produce flooding and mud-flows. In the Valsertal, avalanches and rockfall are highly frequent. The lithological-geotechnical situation (pronounced schistosity and high crack and joint density) leads to a high frequency of rockfall and occasionally to larger rock avalanches (e.g. volume > 110,000 m$^3$ occurred in 2017). In winter, at least 25 avalanche paths are repeatedly problematic in the Valsertal [13].

As in other parts of the Alps, natural hazard process areas that endanger buildings and infrastructure have been preventively managed here for decades.

Especially on the orographic right side of the Valsertal and in the center of the municipality Gries am Brenner, dams, nets and single block protection measures have been installed to mitigate rockfall hazards [14]. The so-called "Sill-Avalanche" has been controlled with steel snow bridges and tripods. Along the Austrian railroad line (ÖBB), the operator itself provides extensive protection. In the Lueg area, where there is a steep rock face located directly above the railroad tracks, protection against gravitational natural hazards has been provided for decades by technical structures of various ages and functions. To protect against flooding, the streambed in the center of St. Jodok (Vals) was extensively expanded a few years ago. All these technical protection measures are implemented (planning and execution) by the WLV as well as by the transport and infrastructure operators ÖBB (railway) and ASFINAG (highway).

The WLV is (besides the Federal Water Engineering Administration) responsible for the protection of settlement areas. The costs of measures are mostly divided between the federal government (main share), the federal states and the municipality (usually the smallest share). For example, extensive protection measures (monitoring with early warning systems, relocation of a road and construction of dams amounting to several million euros) were implemented in 2018–2020 in response to a major rock avalanche event that occurred in Vals in 2017.

At locations that have not yet been or cannot be protected by technical measures, other strategies must be implemented. For example, an avalanche commission convenes several times each winter – on a statutory basis – to assess and avert avalanche damage. Local fire brigades also play an extremely important and indispensable role in disaster response and recovery. These institutions, which are all comprised of voluntary members, are the first responders in case of emergencies. Flooding, soil slides, avalanches and rockfall are in most cases dealt with by volunteer fire brigades during an event. Before and after an event, the WLV and the Tyrolean Geological Survey (Landesgeologie) play an important role as support organizations.

The official hazard zone plans of the WLV are the fundamental basis for spatial planning when dealing with natural hazards (**Figure 2**). For each municipality – including Gries am Brenner and Vals – the spatially explicit hazard zones for avalanches and torrents are shown (**Figure 2**). The process runout lengths and intensities in these plans are based on event documentation, silent witnesses,
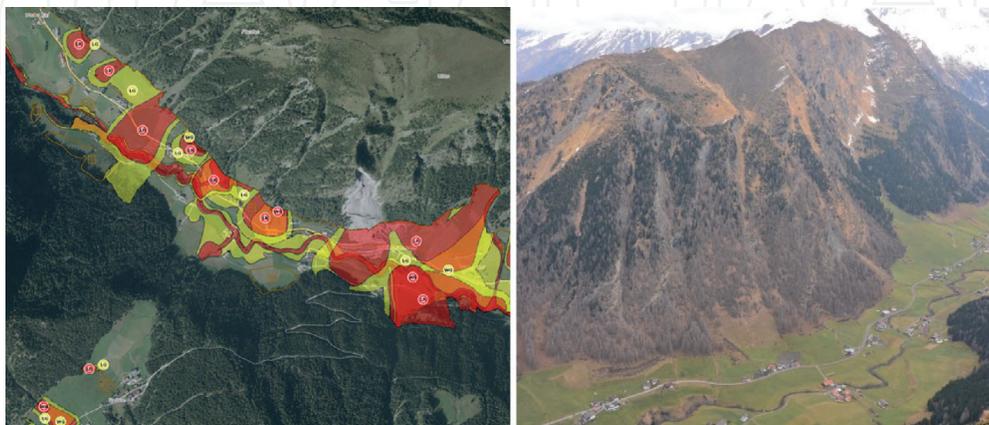


**Figure 2.**
*Left – Excerpt of the hazard zone plan for avalanches and torrents from the Austrian Service for Torrent and Avalanche Control (WLV) in the Valsertal. Source shapefiles: Land Tirol – Department Geoinformation. Aerial image: Google satellite. Right – The southwest-exposed side of the Valsertal. Low building density but pronounced steep slopes of partially unstable rock walls with high susceptibility to rockfall activity. Image source: Matthias Plörer.*

eyewitness accounts, numerical simulations and expert input. The hazard zone plan is the basis for the construction zoning plan and indicates building bans or possible technical requirements for protection against natural hazards. Rockfall processes and landslides are only roughly defined in the official hazard zone plans as hazard indication areas in the spatially relevant areas [15].

Finally, forest management plays an important role in the prevention of natural hazards. In addition to forest rangers, who are employed by the municipalities, the nearby Bezirksforstinspektion (District Forestry Inspectorate) in Steinach am Brenner and the various forestry departments of the Landesforstdirektion (State Forestry Directorate) in Innsbruck are responsible for the management of the (protective) forests to prevent natural hazards.

A strategy that goes beyond the official institutions and includes all relevant stakeholders is described in detail and as our "best-practice example" in the following chapters.

## 2.6 Forests and forestry

### 2.6.1 Share of forest cover

In total, an area of around 3,718 hectares (35.6% of the overall land area) is covered by forest within the municipalities of Gries am Brenner and Vals (**Figure 3**). Other large areas are uncultivated heathland or high alpine rocky landscapes.
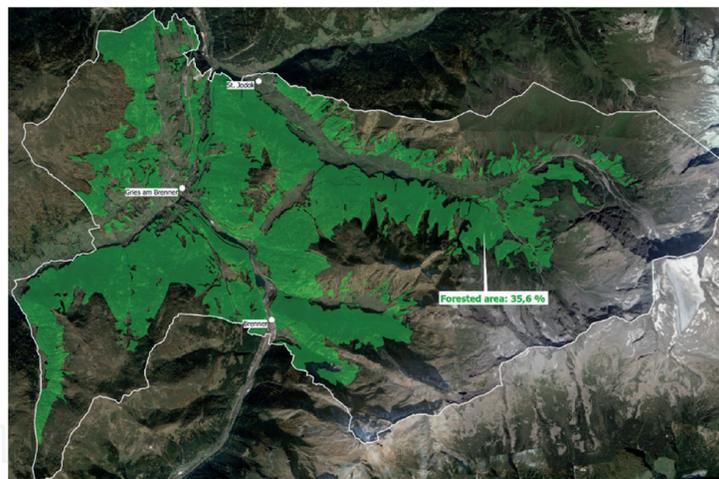


**Figure 3.**
*Recent forest cover in the communes of interest. Source shapefiles: Land Tirol – Department Geoinformation. Aerial image: Google satellite.*

### 2.6.2 Forest categories/forms of operation

The forests in the two municipalities can be divided into (low-yield) protective forest and (high-yield) production forest as well as mixed forms and unstocked forest areas. According to the forest database provided by the Amt der Tiroler Landesregierung (Office of the Tyrolean State Government) – Department of Forest Planning [16], the following forest categories are distinguished (**Figure 4**):

• "WW"      production forest

• "WS2"      production forest with medium protective function

- "SiE"        protective forest in yield

- "SaE"        protective forest out of yield (high forest)

- "SaEK"        protective forest out of yield (krummholz)

- "NHB"        unstocked forest area

As shown in **Figure 4**, 78% of the total forest area in the region is protective forest (protective forest in yield, protective forest out of yield in the form of high forest and protective forest out of yield with krummholz). Production forests, including those with a medium protective function, account for 21% of the total forest area. According to the Tyrolean forest management plans, forests in yield (production forest, production forest with medium protective function, protective forest in yield; 58% of the total forest area) can be managed in a planned and sustainable manner by regular harvesting [17].
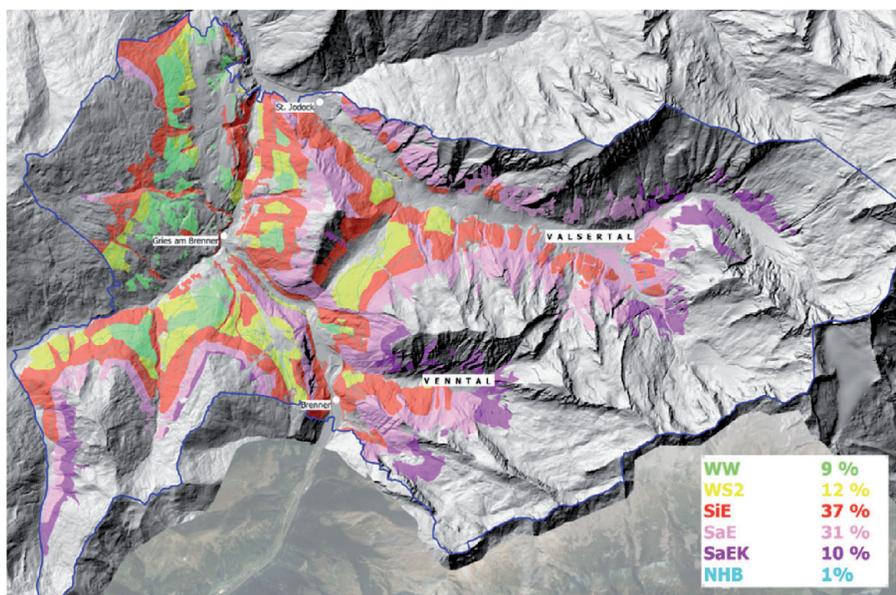


**Figure 4.**
*Forest categories/form of operations. WW: Production forest, WS2: Production forest with medium protective function, SiE: Protective forest in yield, SaE: Protective forest out of yield (high forest), SaEK: Protective forest out of yield (Krummholz), NHB: Unstocked forest area. Source shapefiles: Land Tirol – Department Geoinformation. Aerial image: Google satellite.*

### 2.6.3 Tree species distribution

The description of the tree species distribution in this PAR is based on the Waldtypisierung Tirol (forest typification of Tyrol). For the forest typification, similar forest units – determined by the combination of site characteristics such as location, climate, soil, and potential natural vegetation – were aggregated [18, 19]. This typification is not entirely identical to the actual species distribution, but the potential vegetation is largely consistent with the current one. We categorized forest types based on the forest typification and according to the European forest types (**Figure 5**) [20].

According to the European forest type catalog, type 3.2 (subalpine and montane spruce and montane mixed spruce-silver fir forests) is the most represented with a share of 67% of the total forested area followed by type 3.1 (subalpine larch-arolla pine and dwarf pine forest) with 37% of the total forested area. Types 3.3 and 12.1 occur only in very small proportions.
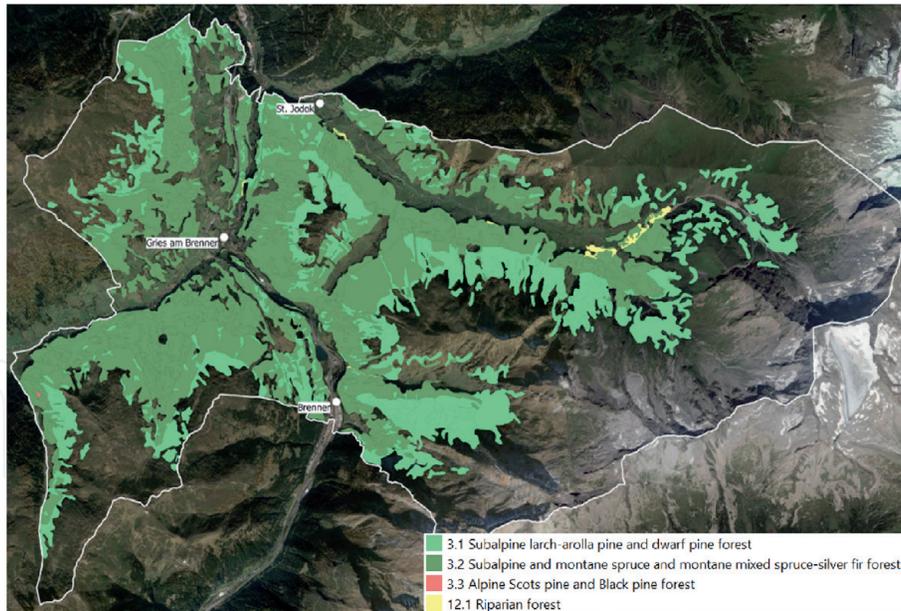
**Figure 5.**
*Tree species distribution according to the European forest type catalog. Source shapefiles: Land Tirol – Department Geoinformation. Modified after the European forest type catalog. Aerial image: Google satellite.*

### 2.6.4 Ownership structure

Forests in Austria can be owned by a wide variety of entities and individuals. In addition, especially in Tyrol, there is the atypical form of the agricultural communities to which municipal property (in the form of forest) was transferred decades ago. These transfers were declared unconstitutional by the Austrian Constitutional Court on 11 June 2008. This municipal property is now owned in an atypical manner by the municipalities as well as the beneficiaries (farmers) and organized as an agricultural community. The municipality is entitled to the intrinsic value of the land. This is the value that remains after agricultural and forestry use by the beneficiaries. The land itself and, for example, the income from gravel extraction is municipal property [21].

In the area of Gries am Brenner and Vals, the following types of property can be distinguished, according to the Tyrolean Forest Database (**Figure 6**) [16]:
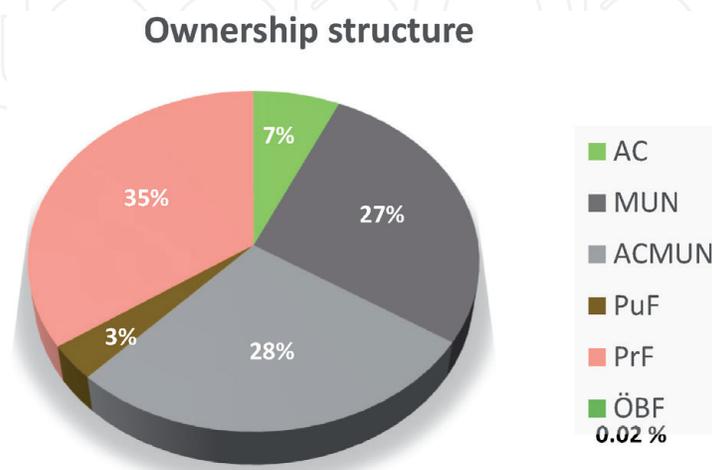


**Figure 6.**
*Ownership structure of forest within the region of Gries am Brenner and Vals. Generated from the Forest database. AC: Agricultural communities, MUN: Municipal property and assets, ACMUN: Agricultural communities from municipal property, PuF: Other public forests, PrF: Private forests, ÖBF: Austrian Federal Forests. Source: Land Tirol – Forest planning department.*

- Municipal property and assets                                    "MUN"

- Agricultural communities from municipal property (atypical form) "ACMUN"

- Agricultural communities                                         "AC"

- Private                                                          "PrF"

- Austrian Federal Forests                                         "ÖBF"

- Other public forests (e.g. State of Tyrol, highway and train line operators) "PuF"

More than one third (35%) of the forest is owned by private individuals (PrF), which often own very small forest plots. The traditional agricultural communities in Tyrol, which are mostly associations of private farmers, own 7% of the total forest area within the PAR. Classical community forest and atypical community forest (community forest with beneficiaries and management by an agricultural community) together account for a share of 55%. Other forests under public law account for 3%.

*2.6.5 Felling quantity/harvested volume*

**Figure** 7 shows data from the forest database of the Provincial Forestry Directorate Tyrol for all forest users (private, public, cooperatives) over the last 20 years [16]. The harvested volume, which includes both pre-use /intermediate cut (thinning, thicket maintenance) and the final use/regeneration cut (including damaged timber removal), varied between 2,000 and nearly 13,000 m$^3$ over the past two decades.
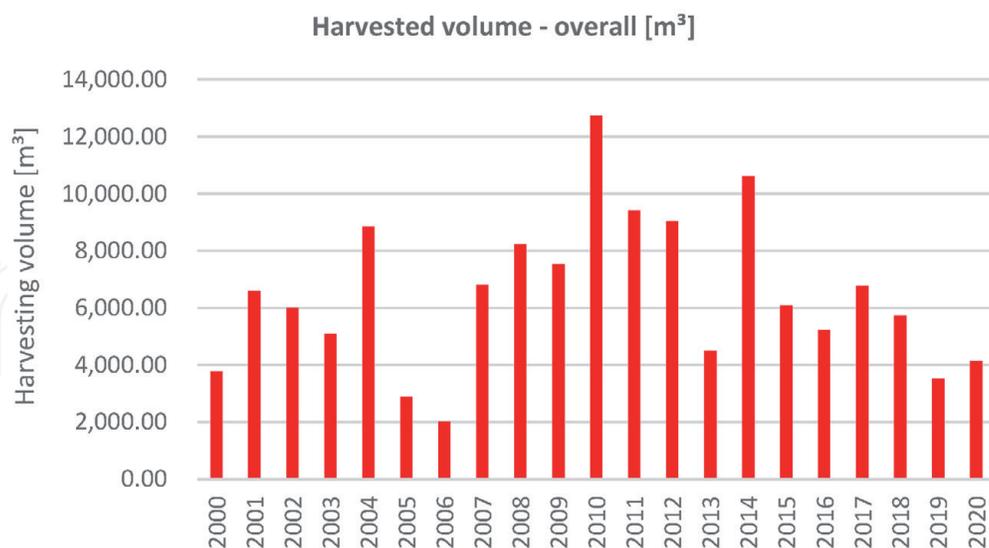


**Figure 7.**
*Harvesting quantity in Gries am Brenner and Vals by private and public use. Generated from the Forest database. Source: Land Tirol – Forest planning department.*

*2.6.6 Growing stock and increment*

The existing forest management plans for the two municipalities record 329 m$^3$ (agricultural community of Vals), 361 m$^3$ (municipality of Gries am Brenner) and 377 m$^3$ (agricultural community of Niedererberg/Fraderwald) growing stock per

hectare. The growth increment lies between 6.0 and 6.6 m$^3$ per hectare per year. Most of the growing stock consists of spruce and larch [17, 22, 23].

These plans were prepared by the Forest Planning Department for periods of 20 years and cover agricultural community forests and community estate forests located in the PAR. Private forest land is not included, so while the data cover large portions of forest land in this region, they do not fully represent it [17, 22, 23].

## 3. "Tyrolean mountains – experience together": Ski tour steering – An example of best practice in the region of Gries am Brenner and Vals, Austria

### 3.1 Introduction

More and more people are enjoying nature through various sports such as hiking, biking, snowshoeing, skiing and ski touring. This benefits the tourism industry as well as individual health along with our healthcare system. However, the increase in outdoor recreation also leads to conflicts. Mountain bikers use hiking trails, ski tourers unintentionally scare game away from winter resting areas and sport climbers trample through farmers' meadows on their way to rock climbing routes. It is usually individual users who do not always follow the rules that make conflict-free coexistence in nature difficult [24].

The program *Tyrolean mountains – experience together* (translated from "Bergwelt Tirol – miteinander erleben") was launched by the Tyrolean government in the spring of 2014. This program includes the management and control of recreational activities in summer (mountain biking, rock climbing, hiking, etc.) as well as in winter (ski and snowboard touring, snowshoe hiking) by involving all relevant stakeholders and representatives from tourism, agriculture, forestry, hunting, politics, nature conservation and landowners, especially in regions or locations where conflicts may arise or have already arisen. To achieve a balance between the interests of the various stakeholders, a large number of institutions are involved in the program, including among others the Tyrolian provincial government, the Austrian Alpine Club, the Chambers of Agriculture & Commerce, the Tyrolean Hunters' Association and Tirol Advertising Ltd. [24].

### 3.2 Ski and snowboard tour steering: an initiative to protect wildlife and protective forests

#### 3.2.1 Basic concept

"Experience the winter mountain world under your own power with climbing skins – skiing started like this – long before our mountains were made accessible by ski lifts. In recent years the sport of ski touring has increased substantially in popularity" [25].

One part of the program "Tyrolean mountains – experience together" is the so-called "Ski tour steering".

According to the head of the mountain sports department of the Austrian Alpine Club, Michael Larcher, the number of people in Austria who practice mountain sports in the form of ski touring is now between 500,000 and 600,000. The Corona pandemic with the consequence of partial ski area closures also seems to be contributing to the fact that, especially in the winter season, more and more people are seeking recreation on touring skis and snowshoes in the forest. Larcher expected a further increase of approximately 20% before the start of the winter season 2020/2021 [26].

The "Ski tour steering" initiative aims to demonstrate that ski touring can be done in an environmentally friendly way despite a massive increase in the number of winter recreationists, if certain rules are followed. In locally implemented ski touring projects throughout the state of Tyrol and together with the project partners and stakeholders, protection zones are defined for the most important protected targets, and measures are developed to not only improve the ski touring experience, but also the coexistence of people, wildlife and nature.

There are areas or specific locations in Tyrol where, due to tourism and recreational activities (ski and snowboard tours), the potential for conflicts with other interests such as hunting, nature conservation or forest management prevail or where conflicts have already occurred. Especially in the context of forestry and hunting, conflicts can arise if tourism activities and recreational sports disturb game or wildlife habitats and, therefore, affect the protective forest.

The 60-page "Tyrolean Ski and Snowboard Touring Concept" [27] (**Figure 8**) was developed by all institutions and experts involved in the program, which contains, among other things, information and guidelines for the following topics:



**Figure 8.**
*Most important topics in the "Tyrolean Ski and Snowboard Touring Concept" [27].*

According to the basic concept, several protected targets must be considered when the elaboration of a steering concept starts (**Figure 9**).



**Figure 9.**
*Protected targets that are identified as important for ski touring projects in Tyrol. The red and green highlighted topics are of particular interest in the GreenRisk4Alps project. Icon made by Freepik from www.flaticon.com.*

### 3.2.2 Protected targets: red deer, roe deer and protective forest

In the context of the GreenRisk4Alps project, the protection of red deer and roe deer as well as protective forest is of particular interest (highlighted in red and green in **Figure 9**). Protective forests can be negatively affected either by human influence or by game. Disturbance of game can lead to an impairment of its energy balance and, as a direct consequence, to increased browsing pressure leading to peeling damage on trees (**Figure 10**) [27].



**Figure 10.**
*An example of severe damage to protective forest caused by red deer. Recorded in the Gries am Brenner PAR. Source: Matthias Plörer.*

### 3.2.2.1 Protective forest—direct damage

Direct damage to forest regeneration by ski edges occur on frequently used ski tour routes and lead to the delayed development of the stand and financial loss for the forest owner [27]. This damage must be taken seriously, and steering measures to prevent it must be undertaken. A distinction must be made as to which protective category the affected forest belongs. In case of damage in object protective forests of priority 1, steering measures that are suitable for reducing the damage must be developed by the regional working group in any case. In the assessment of the extent of damage, the district forestry inspectorate participates [28].

### 3.2.2.2 Red deer, roe deer and the indirect influence on protective forest

Game disturbances in winter are highly relevant because animals are adapted to rest and consume as little energy as possible during this period of food shortage. Animals adapt physiologically to the low food supply and low temperatures. They do this, for example, by lowering their heart rate [27]. However, when disturbed, deer usually respond by increasing their heart rate, which is associated with increased energy consumption [29]. The animals then require more food. Game, in particular, which in the winter season is fed by hunters in Tyrol, has a higher metabolic rate and therefore requires more food to compensate for this when disturbed [27].

Disturbances at dawn and dusk, especially near game feeders, have the most fatal consequences. The game then often avoids the feeding area for a longer period and peeling off bark and eating shoots occur more frequently in protective forest stands. This increases the stress on the forest [30].

Animals can partially get used to disturbances if they are of a similar nature and predictable. Therefore, in wildlife habitats it is important that ski tourers stick to consistent routes and times instead of touring at all hours of the day. Disturbances should therefore be reduced to a minimum if possible, especially in winter [27].

When disturbed by humans, red deer and other game species have the potential to strongly influence and change their habitats through grazing behavior.

In addition, game hunting can be made more difficult when tourists disturb the game. This leads to lower hunting harvest numbers, which then leads to increased peeling and browsing damage in the forest stands caused by a larger number of surviving animals. This can result in a conflict between hunting and forestry.

According to the ski and snowboard touring concept [27], the following key points regarding feeding and disturbance of red deer are important:

- In winter, the habitat of red deer can be delineated by intensive feeding at a suitable, quiet location without hunting pressure.

- Red deer are accustomed to routine touring parties.

- The distance between recreationists and game where there is visual protection (e.g. dense forest) should be 300 m, and at least 500 m without visual protection (e.g. open field).

- Unpredictable skiing through feeding areas is fatal for deer and the forest vegetation, and therefore the protective forest.

- Disturbances have a particularly strong effect at dusk.

### 3.3 The workflow for local ski tour steering projects

In areas with obvious conflicts or in areas where ski touring is to be particularly promoted and advertised for tourist interest, such as in the municipality of Gries am Brenner, a precautionary elaboration of control measures makes the most sense to avoid advanced conflicts which are more difficult to handle [31].
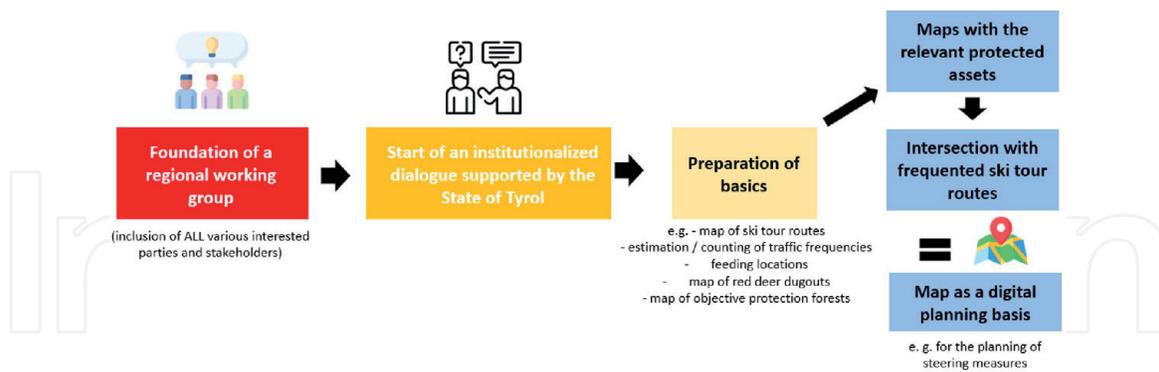


**Figure 11.**
*Scheme of workflow for local ski tour steering projects (after [27]). Icons made by Freepik from www. flaticon.com.*

As outlined in **Figure 11**, the existing problem areas and suitable solution strategies are developed together. This results in a map of the protection zones for different protected targets. The definition of the relevant protected targets is the fundamental core of the respective local projects. However, it is not the goal to cover as many as possible or all somehow relevant protected targets, but to define the most relevant targets to be protected and to focus all further steps on the needs of this protection goal and its interested parties [27].

In addition to the experts and institutions that are in principle involved in the initiative, there are numerous other people and representatives of institutions

that should participate in local steering projects. The local working groups for the development of ski touring control measures consist of all (representatives of) stakeholders, and the success of the projects shows how important such integration forums are to reach a solution that is acceptable to all stakeholders (**Figure 12**) [32].



**Figure 12.**
*Example of the composition of a local working group or integration forum, coordinated by the Tyrolean landscape service (after [27]). Icon made by Freepik from www.flaticon.com.*

### 3.3.1 Preparatory expert inputs

The protective forest areas of interest are based on the current mapping of the Abteilung Forstplanung (Forest Planning Department of the Office of the State of Tyrol). Protective forest categories are differentiated, whereby object protective forests with the priority "3" are of particular interest due to their protective effect for settlements, traffic routes and transportation corridors. Whether steering measures are necessary due to direct damage to the regeneration from skiers, and thus the maintenance of the protective effect is particularly important, is assessed within the working group by the representative of the Bezirksforstinspektion (District Forest Inspectorate). Whether there is a disturbance of game, especially where there is a high game density in a small area, is decided by a representative appointed by the Tiroler Jägerverband (Tyrolean Hunters' Association). Sensitive deer resting areas and feeding locations are made available to the regional working group by those authorized to hunt or by the Abteilung Waldschutz (Forest Health Department of the Office of the State of Tyrol). Maps with all relevant ski tours will eventually be provided by the Tiroler Landschaftsdienst (Tyrolean Landscape Service). The data for this come from the maps of the Austrian Alpine Club, ski touring portals or local experts [27].
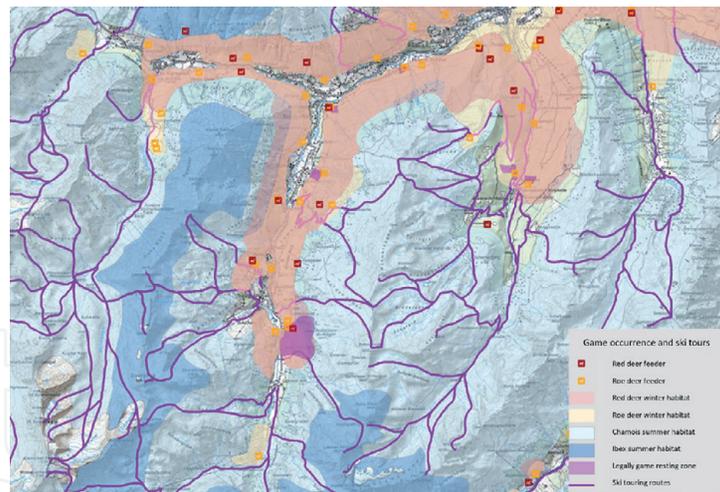
**Figure 13.**
*Map of feeding locations (red and orange dots), spatial occurrence of red and roe deer (red and yellow areas), chamois and ibex as well as official ski touring routes (purple lines). Source: Land Tirol, Forest organization department [27].*

Based on elaborated maps as shown in **Figure 13**, different kinds of steering measures can by implemented. In the following subchapter, the most effective measures of the Tyrolean ski and snowboard touring concept [27] are listed.

*3.3.2 Which measures and courses of action can be implemented?*

The Tyrolean working group for ski tour steering has developed a catalog of measures which basically recommends three different types of measures, and combinations of each (**Figure 14**):
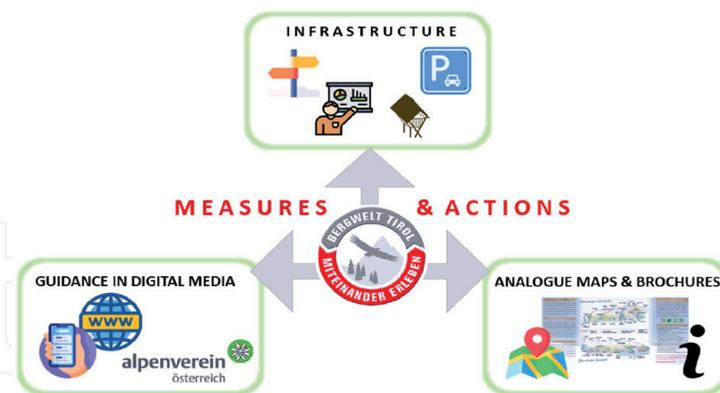


**Figure 14.**
*Possible types of measures and actions for ski tour steering (according to [27]). Icons made by Freepik, Prosymbols & surang from www.flaticon.com.*

*3.3.2.1 Infrastructure*

- Parking lots and parking prohibitions:

  By creating sufficient parking spaces at specifically selected locations, tourers can be redirected to low-conflict routes. Information boards can also be used to provide comprehensive information about game rest areas, ski touring routes, etc. already in place at the parking areas. Parking bans are part of the solution where mass crowds lead to negative impacts.

- Forest paths/routes for ski touring:

  In order to protect adjacent forest regeneration areas or to steer tourers away from game resting places and feeding areas, artificially created forest trails can be an effective measure of steering ski tourers, especially since forest areas and stands have been increasing in Tyrol for decades [33]. However, this approach involves submitting an application in order to be granted permission from the responsible Bezirksforstinspektion (district forestry inspectorate).

- Information boards with ski tours and protection zones & signposts:

  Information boards can be set up, e.g. at starting points for ski tours (parking lots) (**Figure 15**). These can contain low-conflict ski tours, protection zones as well as information on the protected targets and rules of conduct to be observed here. A uniform layout is important for recognition and has been developed by the landscape service (Land Tirol). In addition, guidance can be extended with signposts at strategically important points along the ski tour route.

- Relocation of feeding sites:

  According to §46 of the Tyrolean Hunting Law (TJG), the locations of game feeding sites are to be adapted to local conditions and, if possible, positioned far away from frequented routes of various recreational sports. However, this solution of relocation is usually only considered when other measures have little effect.



**Figure 15.**
*Top right: Structure of a typical information board with ski tour routes, protected targets and protected zones. Top left: Artificial forest aisle with signpost. Bottom: Signpost types for ski tour steering in corporate design [34].*

### 3.3.2.2 Analogue maps and brochures

To be able to communicate the results and requirements of the locally developed ski tour steering measures to ski tourers at low cost, maps and brochures, for example, which are displayed in restaurants or at frequently visited parking lots, are helpful. The distribution and communication by local alpine clubs can also promote this knowledge transfer. Ideally, the protected areas defined in the working groups could also be printed directly on alpine club maps in the future.

To increase the positive perception of ski tourers and promote a uniform image throughout the state of Tyrol, the following steps are important:

- Explanation of the local protected targets with uniform symbols

- Uniform representation of the protected area and/or restricted areas

- Use of the project logo "Bergwelt Tirol – miteinander erleben" ("Tyrolean mountains – experience together")

- Listing of uniform rules of conduct

*3.3.2.3 Visitor guidance and steering with new media*

As evaluations have shown, the decision on where to go on a tour is made at home the day before or in the tourist's accommodation. If winter tourists have already decided on their route, it is very difficult to influence them afterwards. It is therefore important that the relevant information on ski tour steering (protected areas, restricted areas, protected targets, etc.) is readily available in advance in the most important online portals. This transfer to new media is carried out by the Landscape Service Department (State of the Tyrol), which saves work for the local working group and increases the likelihood that the developed concepts will be circulated.

The official homepage of this initiative (https://www.bergwelt-miteinander.at/winter.html), which contains all the important contents of the project and presents them in a user-friendly way, also serves as a basic tool and means of communication for ski tour steering. Among other things, all regional ski tour steering projects are explained, and the "Tyrolean Ski and Snowboard Touring Concept" is available as a PDF for download.

## 3.4 Ski tour steering in the Gries am Brenner region

*3.4.1 Initial situation*

The Obernberg Valley, which is partly represented by the municipality of Gries am Brenner, is a popular destination for ski tourers and snowshoe hikers in winter. Visitors particularly appreciate its natural character, the well-kept rural cultural landscape, the impressive scenic backdrop, easy accessibility and the great variety of ski and snowshoe tours. However, this area is also home to wintering areas for red deer, capercaillie and black grouse. To protect these species, snowshoe and ski touring routes should be designated and should steer clear of their habitats. Therefore, a ski tour steering project was designed and implemented in cooperation with <u>all</u> relevant stakeholders [35].

As outlined in the overall concept, a working group was initiated here to work out the current state, the necessary measures and to answer these basic questions:

- Is there wildlife worth protecting?

- Are forest sites already damaged?

- Are there possibilities to steer ski tourers away?

The local working group is composed of municipality officials, landowners, Austrian Alpine Club representatives, local tourers, tourism association members, hunters, the local forestry authority, nature conservation organizations (e.g. Stubai Alps protected area), a mountain hut owner and the State of Tyrol. All these stakeholders and experts have equal rights and therefore can present their respective concerns [36].

Aside from the committee discussing plans for the region, all ski touring routes were surveyed, visitor counts were carried out at parking spaces and bus stops, the parking behavior of tourers as well as the wildlife habitats were investigated, and the resulting conflict areas were identified (**Figures 16** and **17**) [35].

According to the principles of the "Tyrolean Ski and Snowboard Touring Concept" [27], the project partners agreed on four protected targets after appropriate professional evaluation (**Figure 18**) [36]:
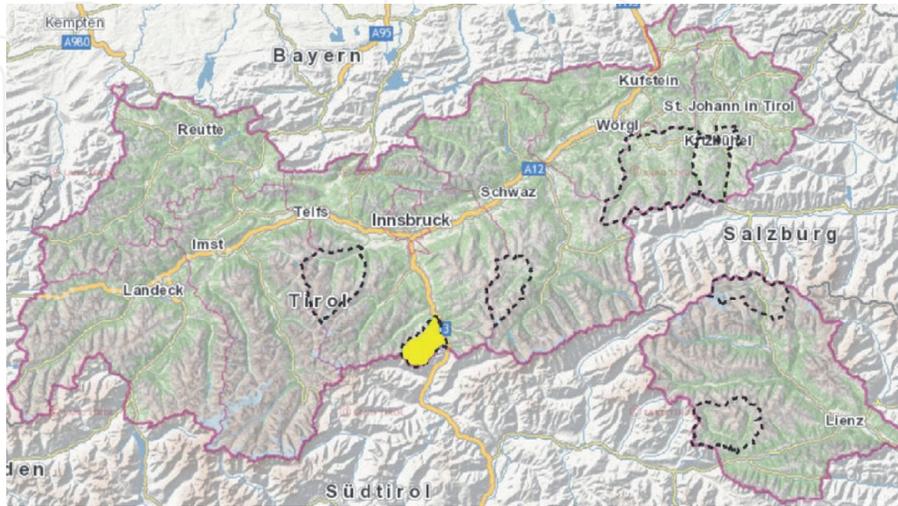


**Figure 16.**
*Projected regions for the ski tour steering program (in black). In yellow: The area of interest near Gries am Brenner. Map source: [37].*
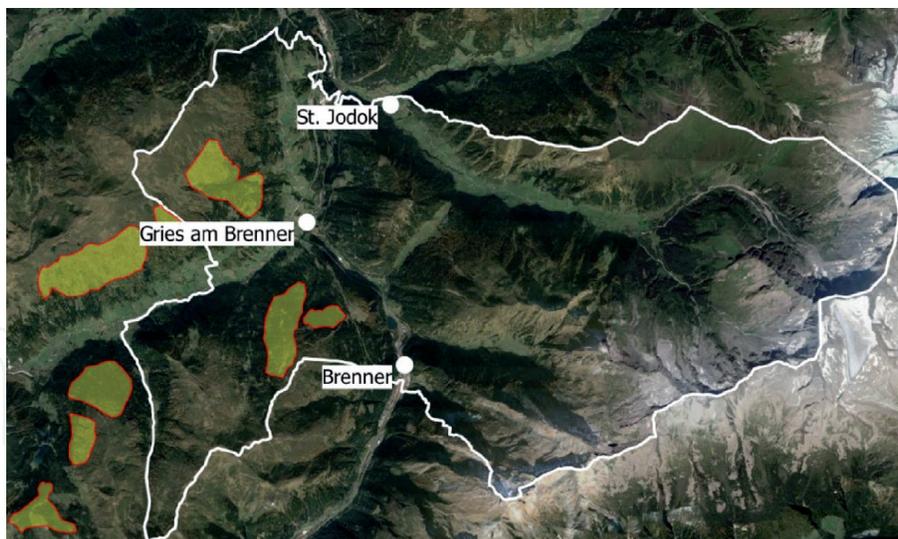


**Figure 17.**
*GreenRisk4Alps PAR (white border) and projected ski tour steering areas (yellow/red). Source shapefiles: Land Tirol – Department Geoinformation. Aerial image: Google satellite.*

- Red deer & Roe deer

- Object protective forest

- Chamois & Ibex

- Capercaillie & Black Grouse

**Figure 18.**
*Signs related to the chosen protected targets in the objective region of interest [36].*

On this basis, nature-friendly routes, a parking guideline and demarcations for voluntary game protection areas were defined.

### 3.4.2 What measures have been implemented?

### 3.4.2.1 New ascent route with signposts

One of the old ski tour ascent routes passed through the middle of a grouse habitat and a nearby red deer feeding location (red sign in the center of **Figure 19**). Due to the high frequency of visitors, there was increased disturbance of game and subsequently also forests at this site. Therefore, a new ascent route was defined and signposted at a sufficient distance from the red deer feeding location and grouse habitat [36].
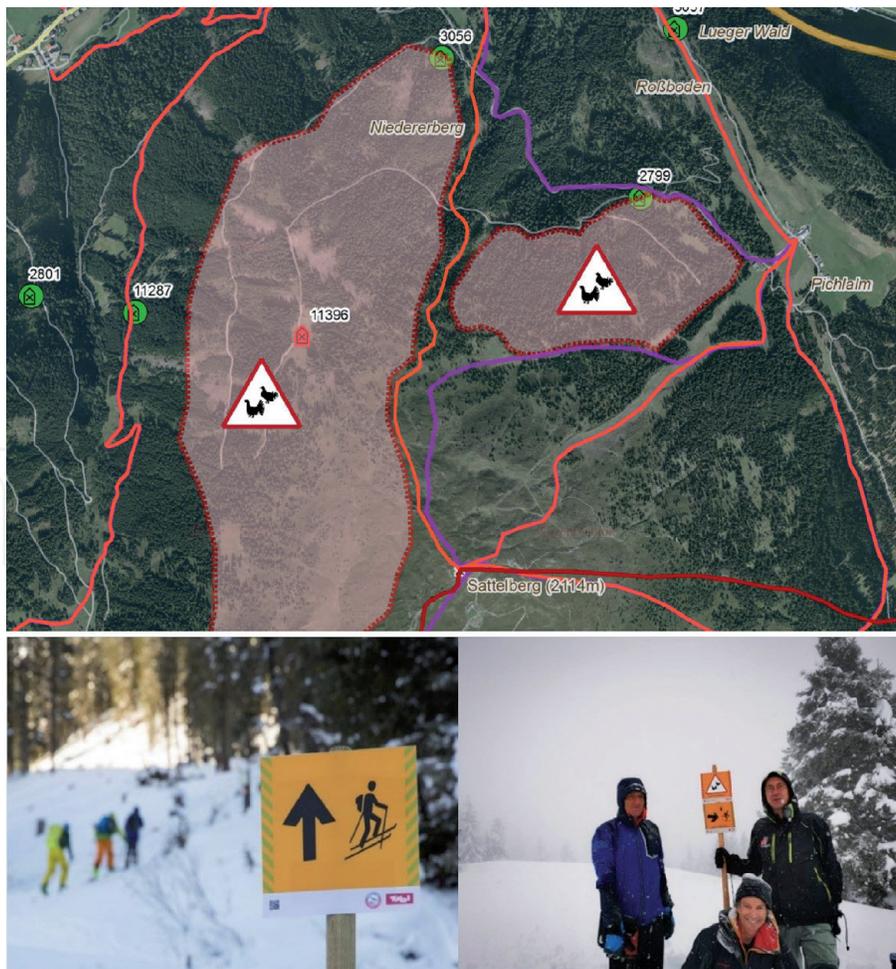


**Figure 19.**
*Top: Overview of the (new) protection zones and (steered) ski tour routes on Sattelberg Mountain. Source: Department forestry organization. Bottom left: Example of signage for the ascent route. Bottom right: Experts installing signage [36].*

*3.4.2.2 Panorama boards*

Easily recognizable panorama boards providing information about the location of the defined forest and wildlife protection zones have been set up at important trail heads in the region. These boards display the most nature-friendly touring routes and adapted rules of conduct, as well as QR codes that provide further information (**Figure 20**) [36].
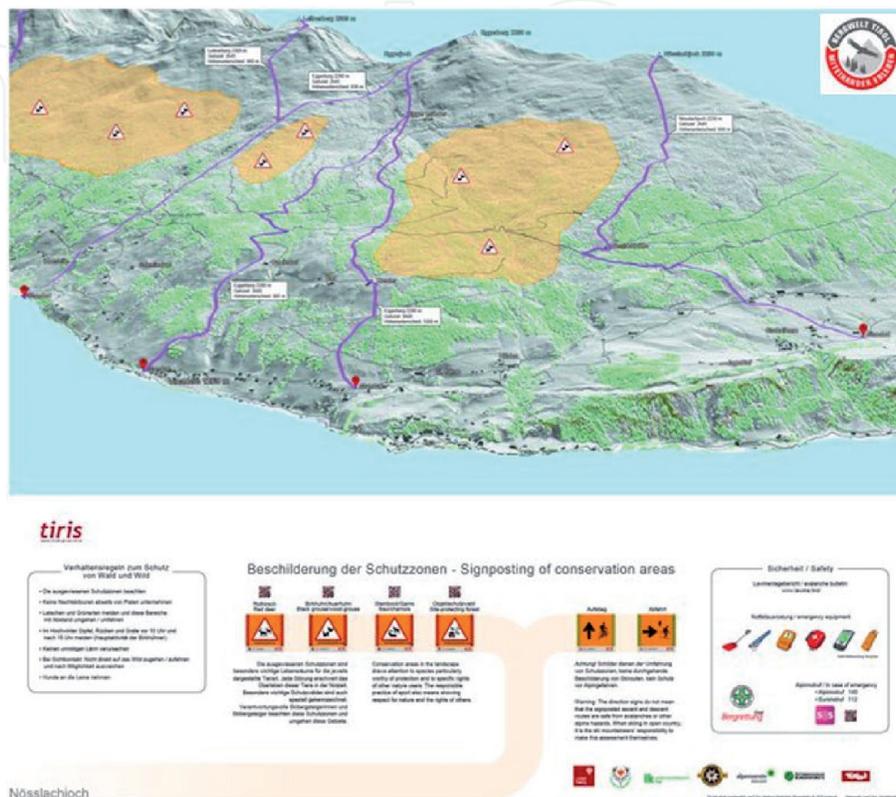


**Figure 20.**
*Panorama board in the objective region with original signposts, suggested nature friendly ski tour routes and safety tips [36].*

*3.4.2.3 Avalanche transceiver checkpoint*

A total of three checkpoints for avalanche transceivers have been set up in the Obernberg Valley (one of them on Sattelberg Mountain). These serve not only as a personal safety check for everyone, but can also record visitor frequency [36], which is particularly helpful for the overall conception of the measures. However, recreationists without avalanche transceivers are not recorded in the survey.

## 4. Effectiveness of measures/lessons learned

It has been proven that in the projects implemented so far, the targeted surveys and measures have led to a reduction of disturbance factors towards sensitive game and also to a reduction of the negative impacts on the surrounding object protective forests [38].

A webinar held on 20 January 2021 showed that the project described here is not fully completed but is still an important topic of interest and is continually being discussed. The project managers of the Amt der Tiroler Landesregierung (Office of the Tyrolean Government - Department of Landscape Service) invited more

than 40 relevant stakeholders and experts from various fields and institutions. Among others, important representatives from the Austrian Alpine Association, the Tyrolean Hunters' Association, the Forestry Directorate of Tyrol with its sub-units, the Tourism Association, Austrian Federal Forests, Tyrol Advertisement Ltd., the Tyrolean Chamber of Agriculture, as well as professional hunters were involved in this meeting. At the beginning, the project initiator presented a status-quo report and practical examples by means of video contributions, which was followed by a lively discussion. According to the meeting minutes of the webinar [38], the following issues were discussed:

- Recent analyses show that the density of tracks (skier lines) in some sensitive areas is still too high despite steering measures. It was noted that ascending skiers are easier to steer than descending skiers, who look for un-skied/tracked areas, e.g. in fresh powder snow. In wide open terrain, the installation of analogue guidance systems is difficult to carry out without considerable effort. Another cause of overuse in sensitive areas arises from ascent routes that have been established for decades, and it is therefore often difficult to persuade locally experienced tourers to use new routes. In already projected regions, the evaluation of visitor frequency (tracks in the snow) will be continued. Continuous optimization of the measures is sought.

- In printed literature such as guidebooks with ski tour descriptions, the desired current state of possibilities (ascent routes, avoidance areas, etc.) is often not yet available. Publishers are sometimes slow to include this information, which needs to be improved.

- In addition to the already established steering measures, the targeted creation of a first track after fresh snowfall would be interesting. Local ski tourers (e.g. on behalf of the Austrian Alpine Association) could create the first correctly running track in order to successfully guide following recreational skiers.

- Even if the intention is only to steer ski tours with particularly strong conflict potential, there is a desire – especially on the part of the hunting association – to speed up the project planning to other areas. Negative hotspots that have been eliminated so far are showing positive effects, but there are still regions where, e.g. due to disturbance of game, shooting plans cannot be achieved. It should be kept in mind that the basic idea behind these projects requires the involvement of all relevant stakeholders, which requires a considerable amount of time and commitment.

- Since ski touring is growing at a fast rate, the topic at hand is becoming increasingly widespread in terms of time and space. In the future, it will be important to raise more awareness within the ski touring community and to make it known that designated protection zones are off-limits for everyone. To be able to identify the location of such protection zones in the terrain, touring platforms need to integrate them into their online services and apps. In addition, social media campaigns of several stakeholders and project partners should be promoted (e.g. avalanche.report, bergfex.at, almenrausch.at, etc.)

- In general, it is important to increase acceptance and awareness of the problem among the public. It will be important to raise concern about the needs of the game and the condition and importance of the protective forest.

Finally, it was noted in this webinar that an overview of related or similar projects as "the best of" from all Alpine regions would be interesting. In principle, the steering concept could be raised to an international level [38], which has already been implemented with the description in this "Best Practice Book" and can thus be promoted and implemented beyond the region of Tyrol!

## 5. Conclusion

The Tyrolean Ski Tour Steering Concept has been successfully implemented in Tyrol since 2014 and continues to be improved with new ideas involving all relevant stakeholders. So far there have been concrete elaborations of these steering concepts in six Tyrolean regions (**Figure 16**). The successful implementation of local ski tour steering projects contributes significantly to the protection of wildlife and subsequently also to the protection of protective forests. Through targeted surveys of visitor frequencies in sensitive areas, game resting areas, feeding sites and important object protective forests, spatially-specific hotspots can be identified, and measures can be adapted to and implemented in the respective area. The ski touring steering concept clearly demonstrates the importance of integrating all stakeholders in the planning of such governance mechanisms, especially in the case of conflicts, in order to find a satisfactory solution for all parties involved [32].

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