

**A Case Study of Lech, Austria
Examining Effective
Destination Management Strategies in a Ski Resort**

**By
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This paper is an excerpt from a post graduate research project
conducted in association with the
International Centre for Responsible Tourism entitled

**An Investigation into the Role of Ski Tourists' Level of Awareness of
Responsible Tourism Issues in Determining Destination Choice**

The full document is available at
www.icrtourism.org

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1 Introduction

This case study is an excerpt from a post graduate research project conducted in association with the International Centre for Responsible Tourism. The aim of the research project was to investigate the role of ski tourists' level of awareness of Responsible Tourism issues in determining destination choice. In order to fulfil the aim of this research project the following objectives were explored:

- ◆ Understand skiers' motivations in resort selection and their existing levels of awareness about Responsible Tourism issues in taking a ski holiday
- ◆ Understand skiers' levels of awareness of actions taken to mitigate Responsible Tourism issues in a leading resort and whether personal experience and information provision will influence future choice
- ◆ Understand key ski informants' perspectives on issues, levels of awareness of actions taken to mitigate Responsible Tourism issues in a leading resort, and whether there is a desire for better information provision.

In order to investigate whether skiing and ski resorts could possibly be compatible with Responsible Tourism, a case study was conducted into Lech. Lech was selected as the focus for the research since it was reputed to be one of the resorts in Europe that was doing the most to develop in a responsible manner and one of the best mountain resorts managing to balance their tourism business with the protection of the community and the environment. This was suggested by Mr Oskar Hinteregger of the Austrian Tourist Board in London and was verified on the website of Patrick Thorne in his Green Snow Database in 2006. Lech/Zürs was one of only three European resorts to have received his five star rating. The other two were Neustift and Tux, both of which are much smaller resorts and, therefore, not such good destinations for quantitative research.

The investigation into the destination management strategies in place in Lech was designed to fulfil two purposes. Firstly, the interviews sought to understand exactly what the destination management actions in place in Lech are, and whether they are successful. Secondly, the investigation would enable a list of actions to be used in the Skier On-Trip Questionnaire. This questionnaire would discover whether skiers were aware of resort practices and features before or since their ski holiday in order to see whether it is noticeable and, having experienced skiing in a responsibly managed resort, whether they would seek this out in future.

The research was organised into four areas in order to derive the information to fulfil the aim of the project:

Resort Key Ski Informant Interviews

In association with the tourism office of Lech, a set of interviews were conducted in person in Lech to understand the destination and activity management strategies in place. These were semi structured interviews carried out in person. The informants included the head of the local tourism office, the head of the ski lift company, the mayor, the developer of the Oberlech tunnel system and representatives from the Biomass plant, organic purification plant and lift manufacturing companies. The information derived would provide the facts for two other parts of the research project; the Skier On-Trip Questionnaire and the UK Key Ski Informant Interviews.

Skier Pre-Trip Questionnaire: A quantitative questionnaire for British skiers conducted pre-trip in the UK investigating skiers' motivations in destination choice and awareness of the impacts of skiing. The questionnaire was conducted in person in airport check-in queues on flights to Austria during the ski season.

Skier On-Trip Questionnaire: A second quantitative questionnaire for British skiers conducted in Lech, focussing on the motivations in destination choice and awareness of the responsible destination management strategies in the resort (gained from the interviews). This was a self completed questionnaire.

UK Key Ski Informant Interviews: A second set of key ski informant interviews were conducted in the UK to investigate perceptions of skiing and awareness of ski resort practices. These were semi structured interviews and were conducted over the telephone. The informants were tour operators who featured Lech, journalists and ski travel agencies. The interviews sought to discover whether the key informants believed there were any negative impacts associated with skiing and whether

they were aware of the destination management strategies adopted in Lech. The remainder of the interviews focussed on the role of the informant in disseminating this information.

As part of the research project, an extensive literature review was conducted to review the concepts surrounding winter sports tourism but also to bring together all the current scientific research into the impacts of skiing on the environment where much confusion exists. This is also available separately at www.icrtourism.org

A paper summarising the results and conclusions of this research project, in addition to the full research project, are also available at www.icrtourism.org.

2 Location

Lech is situated in the Vorarlberg – the most westerly state in Austria.

Plate 1 - The Vorarlberg in Austria



Lech, together with Zürs, Stüben, St. Christoph and St. Anton, form The Arlberg ski region named after the pass that connects the Austrian provinces of Tyrol and Vorarlberg.

Plate 2- Lech in the Vorarlberg

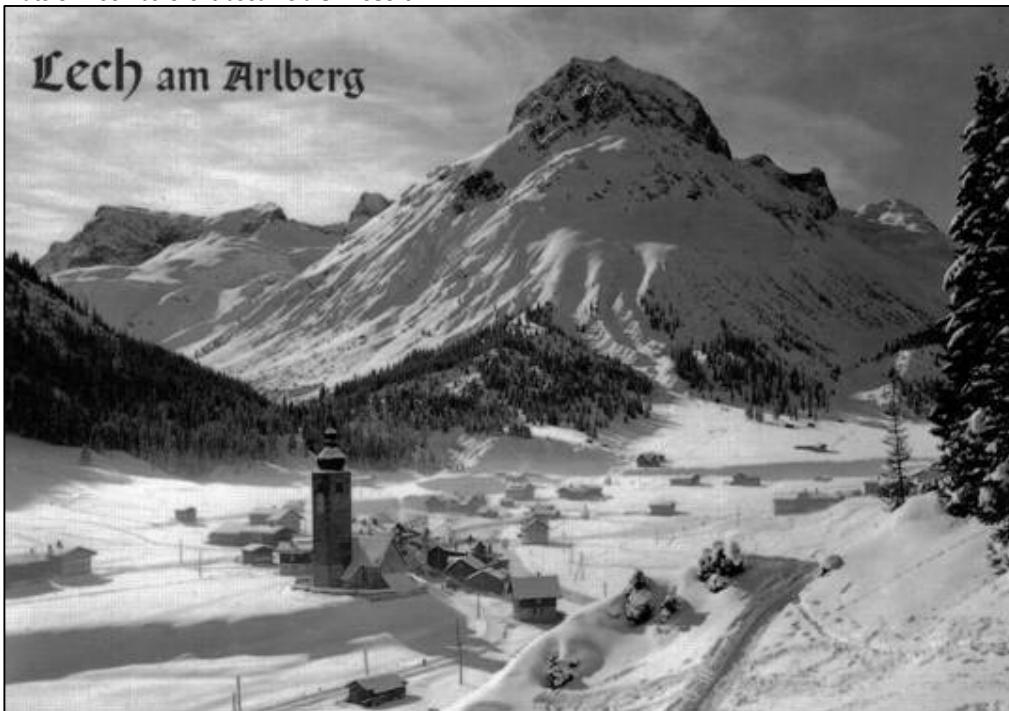


3 History

The history of Lech can be traced back to the Bronze Age, when people not only used the area as a passageway through the mountains but also grazed the grassy areas above the tree line. Many clearings were made in order to increase the grazing area. The history of settlement in Lech began in the Middle Ages when a small settlement developed due, again, to the quality of the grazing land. Mountainous agriculture dominated with farmers exclusively living on dairy farming and animal husbandry – other agriculture was limited due to climate. In winter, the village became isolated from the outside world as only mule tracks and wagon trails led into the high valley – often cut off by avalanches.

The remoteness and at times difficult accessibility of Lech resulted in a high degree of independence. However, during the French Wars at the beginning of the 19th century, Lech was forced to provide soldiers. Together with a slump in cattle prices and growing industrialisation in the Rhine valley later in the century, 31 farms closed and many people left Lech; the viability of the town was threatened. It was almost impossible to halt the economic and social decline of the town.

Plate 3 - Lech before it became a ski resort



The incumbent mayor tried to reverse the decline by, amongst other achievements, setting up an Alpine dairy cooperative society and initiating the building of the Flexen Road, which was completed in 1897, to improve accessibility over the Flexen Pass which rises to 1773m. The improved access coincided with the discovery of skiing and heralded the beginning of a new era for Lech. Skiing pioneers from the Lake Constance area came to the Arlberg and declared it as the ideal area for winter sports. Any early improvements in the beginning of the 20th century stalled during the First World War but in the intervening period between the two World Wars, the population working in tourism doubled and the number of guest beds increased from 100 to 1,221. The first ski lessons were provided to guests in 1923. Despite the world economic crisis, Lech continued to invest in tourism and in Christmas 1937, Austria's first ski lift opened on the nursery slope in Zürs. After the Second World War, the local population looked forward with hope and saw their future in tourism; overnight stays trebled between 1948 and 1951.

The local population gradually increased to its current level of 1500 permanent residents. Their independence and close community spirit led to a determination to retain control of development to maintain their small village and work to conserve nature and protect the quality of their local environment.

4 Lech Today

Lech and Zürs have earned a reputation of being a skier's paradise and a quality destination. Lech promises a certain level of luxury and promotes itself with the slogan "More space, more time". All materials from the brochures to the website give an impression of a quality destination, with beauty and peace. Lech is a member of the 'Best of the Alps' select group of ski resorts, representing the most prestigious winter sports and summer holiday destinations in Europe's Alpine countries; market leaders in the way their infrastructure has evolved, their close natural relationship to the surrounding areas and the perfect mixture between established tradition and carefully nurtured progress.

For four years in a row the Arlberg has been rated among the top ski resorts around the globe by the experts of Skiresort Service International in their worldwide evaluation. Lech has always believed that nature and the environment should form the basis for any future development. Lech has been awarded many prizes for its efforts to improve nature, the environment and the appearance of the village. Lech received the "Rock Crystal" award from the Alpine Protection Association and, in 2004, was awarded 'The Most Beautiful Village in Europe' by the Entente Florale.

Today Lech and Zürs have a population of about 1,500 and offer 8,740 beds for guests. Annually, they provide a total of almost 1 million guest nights: about 800,000 during winter, about 150,000 in summer. This emphasises the importance of the winter season. In the height of the winter season, the population including seasonal employees (3,500) and guests can rise to 14,000.

Table 1 - Accommodation in Lech

Accommodation	Percentage
5 star hotels	8%
4 star hotels	48%
3 star hotels	30%
2 star hotels	6%
Apartments	1%
Private homes	7%

Lech attracts a very international clientele, but the highest proportion of winter guests come from Germany (460,000 bed nights), but this has been falling in recent years possibly due to the economic difficulties in that country. Austrians account for around 160,000 bed nights. The number of British guests staying in Lech is rising annually and is currently approximately 90,000 bed nights; this shows the importance of the British Market to Lech. The Swiss and the Dutch both account for around 40,000 bed nights. Lech also attracts a loyal clientele who return year after year. Through monitoring guest arrivals they have found they have 20,000 people who have been for more than 10 years. At a celebration weekend for regular visitors 2,000 people turned up.

In the 2005/06 winter season, Lech enjoyed full occupancy on 99 days of the winter season. In a comparison with competitor destinations in both Austria and other "Best of the Alps" resorts in Europe, only two resorts had higher numbers of nights of full occupancy; Ischgl with 115 nights and Sölden with 111. Megève in France and Davos in Switzerland both managed to only achieve full occupancy on 51 nights in winter. This emphasises how carefully Lech has managed its bed numbers in order to maintain demand and good occupancy figures.

As discussed, the winter season is vitally important to Lech. The season generally starts at the beginning of December and finishes late April, the lift opening and closing dates marking the beginning and end of the season. It is promoted as a resort for all abilities with a range of pistes for all levels and off-piste terrain and itinerary runs for advanced skiers. Together with the other resorts of the Arlberg there is a limitless supply of skiing terrain. Lech and Zürs together have a total of 110km of pistes available; 22 expert, 44 intermediate, 44 beginners. There are 4 cable cars, 18 chair lifts and 10 drag lifts which have a total uphill capacity of 44,668 people per hour. Additionally, there are three cross country ski runs totalling 19 km and two prepared mountain hiking paths, however, this is relatively low in comparison to other resorts. Other winter facilities include indoor tennis courts, squash courts, outdoor ice-skating, curling, tobogganing, indoor ice-skating, feeding wild animals, horse-drawn sleigh rides, guided walks, mountain tours, two small local museums. There is a variety of shops and services and over fifty restaurants.

The summer season generally runs from late June to the beginning of October, also determined by the operation of the lifts. The beauty of the mountains in summer is promoted as the perfect environment for a variety of outdoor activities; hiking, biking, climbing, fitness, outdoor swimming.

5 Managing the Destination

5.1 The Village

5.1.1 Development and Architecture

The residents of Lech together have kept control of the destination. They embarked on their first planning exercise after the Second World War and then again in 1980. Working with specialist consultants to plan the way forward they set about creating policies to govern development into the future to maintain a balance between economic goals and preserving the beauty of the natural environment.

There is a strict zoning policy which governs development based on safety grounds; avalanche and flood. Red zones where no building is allowed, yellow zones where some building is allowed but with restrictions and green zones where there are no restrictions based on safety. Further to this a set of laws were put in place to limit the growth of buildings and the amount of each plot which may be built on and the amount which must be retained as open space. The local law also determines how many beds may be within a particular building, the height and number of floors and provides guidelines on architecture and materials. A positive decision was made to limit the number of beds - never to be more than 10,000. In order to maximise revenue, they also decided to increase the number of four and five star hotels (and ensure all other accommodation was of a very high standard – even the private bed and breakfasts) and concentrate on increasing occupancy levels. Currently, no more apartments are able to be built as they feel the correct balance has been reached (1%).

All plans are submitted for review. A Committee reviews them for compliance with all the regulations and neighbours to the planning site have the option to comment.

There is no second home ownership permitted in Lech, 'outsiders' may only buy if they make Lech their main residence.

5.1.2 Ownership and Employment

All businesses in Lech are 100% locally owned - ownership gives the care, commitment and feeling of protection. A business may be run by an 'outsider' but this is very rare. This has evolved and there is no law about this. There are no specific Austrian laws regarding employment since they follow EU legislation, however, there is a strong guest expectation that all public facing staff will be Austrian. Lech does not have difficulty in attracting staff; since it is a quality destination many people want to work there for their curriculum vitae. Lech is increasingly attracting workers from Germany and Bosnia and Serbia. In winter there are 3,000-3,500 extra seasonal workers, in summer there are 1000.

Most people in Lech do work in tourism, but there are some other jobs that are supported because of tourism – for example the village can support four doctors. However, it is concerning that there is a complete reliance on tourism. There are 18 farmers, which has remained static for a long time now indicating that it is worthwhile – however, it is not viable as a single income – most farmers have secondary jobs. Farmers also receive income where their land is used as a piste in winter.

5.1.3 Transport and Pollution

Guest questionnaires and feedback raised the issue that the traffic in the village, and the resulting congestion and pollution, was marring their stay in Lech. Only 10% of guests use public transport to reach Lech although efforts are being made to reduce this. Lech has organised shuttle buses from all the major airports and some of the minor airports with limited success, culturally this has been difficult with the Asian market particularly who see this as a little "downmarket". Additionally, Lech is trying to promote train travel and has organised taxi shuttles from Langan, the nearest train station. However, with the majority of the guests to Lech coming from Austria and Germany, still a large number are choosing to drive.

Lech developed a plan to create a year-round town bus service for locals and guests. It was funded partially by ski pass/summer pass sales and partially by the Federal Government and the Province of

Vorarlberg. However, it still requires subsidy on an annual basis but unanimous voting by local residents has ensured that this is paid for out of the local taxes. The bus also runs in the interseason periods on a limited schedule for locals only. There is a network of lines covering all parts of the villages of Lech, Zürs, Oberlech and Zug and they are mapped out simply with colour coded lines to be easy to use for their international clientele. Now many guests who drive to Lech, park their cars on arrival and do not use them again until they leave. Lech has built a number of underground car parks to cater for this. The bus also runs on a schedule throughout the night to ensure safe return of staff and guests at any time and reduces noise and disturbance as people are not waiting around for transport. The bus is free to all guests and locals and it has been a tremendous success. As well as reducing congestion, pollution and CO₂ it has been very popular with guests as detailed below:

Table 3.2 - Lech Town Bus Usage and Development

Summer			Winter		
Year	Passengers	Vehicles	Year	Passengers	Vehicles
1997	166,000	4	1997/98	850,000	9
1998	208,000	6	1998/99	995,000	10
1999	221,000	7	1999/00	1,050,000	10
2002	225,000	9	2002/03	1,090,000	11
2003	238,000	10	2004/05	1,150,000	12
2005	247,000	10	2005/06	1,250,000	12
2006	254,000	10			

5.1.4 Energy and Pollution

As mentioned earlier, air quality was not good about 10 years ago, caused by the traffic as detailed earlier and emissions from private homes. This was particularly visible at times of inversion when the temperature in the valley was lower than the temperature at the top of the mountain. This traps the air and pollution and, when it is visible for all to see, this damaged the perception of Lech.

The village decided to build a biomass plant at the entrance to the village where the land is higher and where the flow of water would be aided by gravity. The Biomass Plant is supplied with a renewable mixture of woodchips and bark which are the waste products from local sawmills which otherwise may have been exported. One year of heat for the entire village can be obtained by 70,000m³ of woodchip.

Building began in March 1999, and by October the first buildings were being connected and by 2001, 213 buildings were connected. All 223 buildings in Lech are now connected and there are plans for a new plant to serve the Zug valley. There are two full time members of staff and two part time.

The Biomass Plant provides heating and hot water for 97% of all local energy needs. At times of very high demand there is sometimes the need to top up with oil (3%), however, they now save the use of five million litres of oil by using Biomass. They have cut their CO₂ emissions by over 50%; 6,600 tons fewer per year and there are 7 tons fewer SO₂ emissions.

5.1.5 Waste Management

In the 1970s, when the number of hotels was increasing and to prepare for growing bed numbers, a new organic purification plant was built in Lech at the lower end of town in Stubenbach, again in order that gravity would aid the flow of water. There are four full time members of staff.

100% of all buildings in Lech, Zürs, Oberlech and Zug including mountain restaurants and huts have their waste water and sewage removed via a 3km long pipe which connects them to the purification plant.

The water is purified through a four-stage process which is totally organic - no chemicals are used. The four stages are 1) removal of solids/heavy materials, 2) removal of oils and fats, 3) the pumping through of air which creates bacteria which clean the water and 4) the aeration of the water via turning plates which simulates the water flowing over rocks and completes the cleaning. The process takes 24 hours from inlet to outlet. The water is fed straight back into the river and is monitored several times a day every day to check the quality.

The solids and waste have the remaining water removed and are then processed to create methane gas which is used to run much of the machinery. Some electricity is also used to run the pumps etc.

Domestic waste removal follows the very strict rules of the Province of Vorarlberg, there are no local laws. The province charges to remove waste hoping to encourage less waste overall. It then requires that all waste be separated five ways; paper, glass, plastic, tin and biomass and any waste that cannot be recycled incurs a variable charge per kilogramme.

5.1.6 Oberlech Tunnel System

In 1995, after 12 years of discussions, some of the hotel owners in Oberlech decided to build an underground tunnel system to handle supplies to and from the village. Oberlech is a hamlet situated above the main village of Lech at an altitude of 1650m connected via a cable car that runs from 7am to 1am. Whilst there is a private road to Oberlech in summer, in winter the snow is not cleared and Oberlech becomes a car free village.

However, this peace was constantly disturbed by 12 skidoos and 14 diesel track-chain vehicles operated in the car free village every day, transporting guests and their luggage from the cable car station to their hotels. According to records of the cableways, approximately 12,000 containers of guest luggage are transported in a winter season. Additionally, all hotel supplies and waste were transported in this way; disturbing the peace, polluting the air and defeating the purpose of the car free village.

The purpose of the tunnel system was to relocate the supply and waste removal system from the surface to below ground and enhance the visitor experience. Building began in 1997 and took three years to build since construction could only take place out of the summer and winter seasons ie, for 4 months of the year.

The tunnel links 15 hotels, no private residences are linked although they may utilise the underground parking facilities. The tunnel is well lit, clean and bright with escape routes every 40m, battery operated lighting, security cameras, fire precautions etc. The tunnels measure nearly a kilometre in length.

The private road splits where the snow is not cleared and heads 300m along an approach tunnel underground to a turning area where the deliveries and waste collection take place. All supplies are transferred to electric cars to be transported to the individual hotels. Waste from the hotels is removed by electric car and stored in the waste collection area from which the village refuse trucks collect it.

Guests still arrive by cable car and their luggage also arrives by cable car, however, the top of the cable car station is linked to the tunnel and thus from there, both the guests and the luggage are transported to the hotel by electric car. Guests are issued with swipe cards allowing them access to their own hotel from the underground – they may wish to use the tunnel to get to the cable car to go down to the village for the evening, generally however, during the day they would ski from the door of their hotel.

The tunnels have restored the peace and tranquillity to Oberlech in winter and it is popular with families for the safe car free environment.

5.1.7 Culture

Whilst the nature of the tourism in Lech is seasonal, there is no desire to try and extend the seasons further to become a four season resort. The period from the end of April to the end of June and the period from early October to early December are important times for the community to have the village to themselves, take some holidays and revive their cultural traditions. Indeed all the public holidays from Christmas through to Easter, that residents are unable to take up due to the ski season, are saved up for a special week of holidays in May. Summer is the time for maintaining local culture and heritage, with festivals, local costumes and traditional music. These are important to the local community and are not commercialised and put on for tourists - in the view of the locals this would devalue them.

5.2 The Mountain

5.2.1 Ski Lifts and Facilities

All ski activities and lift operations are ISO 14001 accredited for the environmental management of the operations. In Lech, all the lifts run on electricity (not diesel) which in the Vorarlberg is derived from a renewable source - hydroelectricity. None of the lifts is powered by solar energy - however, solar energy is used to heat a couple of the lift stations up the mountain and for heating the garage housing the piste grooming machines and the water used to clean them.

Many of the lifts in Lech are relatively new; they tend to be replaced every 20-25 years. This has meant that where, for example, there were two two-man chairlifts side by side from the village, there is now a single four-man chairlift, thus reducing the numbers overall. This has meant that several lift pylons have been removed to reduce the visual impact. The new chairlifts are 'detachable' meaning that the chairs are removed when not in use and housed in a garage, either as part of the lift station or underground. Again, this means that the visual impact is reduced as there are no chairs visible when the lift is not in use, only the cables, and that fewer lift pylons are required due to differences in the weight distribution. The most recent lift stations are much smaller than before with lower overall height, and the machinery and motors underground in order to keep noise levels down. They are also able to recuperate heat from the motors to heat the rest of the lift station.

Currently there is a proposal to create two new lifts and pistes to link the ski area of Lech to the ski area of Warth, a nearby village. This is an example of the way ski areas in Europe are able to expand now – no new resorts are allowed, thus the only way is to link ski areas. It raises the current dilemma regarding development. Warth is a poor village with a small ski area that struggles to attract enough skiers to make it worthwhile, the road between the two is closed in winter. Linking to Lech would give it the volume of pistes and the profile to attract more people, though in Lech, residents are less enthusiastic; they feel they have enough piste and do not want to lose custom to a nearby resort or dilute the quality they have maintained.

In order to gain permission for a new lift in the Vorarlberg, a full business case is required, with details of the rationale and the proposed system and routes. The proposal must contain detailed construction plans with maps/cross sections, geological information and details of how the land will be restored. It must consider the landscape, watercourses and watershed, avalanche risk, natural flora and fauna and all stakeholders. There are independent planning offices to help with this process. Any lifts above 1800m face further restrictions and all projects over a certain size are required to undergo the Austrian environmental impact analysis - Umweltverträglichkeitsprüfung. It is for the resort to carry out all this work, the lift manufacturer will only act as consultant. All the plans must then be sent to the District Government - Bludenz is the district covering Lech. The provincial government in Bregenz must give the permission for the construction and has an independent environmental consultant review the plans on behalf of the Vorarlberg. The Austrian Cable Car Law governs the technical regulations pertaining to the creation of the new lift. As can be seen there is no single set of requirements for the construction of a new lift - every lift is addressed on a case by case basis – however, the combination of the various Austrian requirements are the toughest in Europe.

5.2.2 Piste Creation, Maintenance and Artificial Snow

The changes made to the landscape around Lech in the middle ages, when certain areas of forest were cleared, has meant that no trees have been removed to create pistes and very few changes to the land have been required. Between 1978 and 2000 there has been an international congress chaired by Mr Manhart of Skilifte Lech, on how to correctly manage the creation of new pistes to minimise the impact to the environment. They have now perfected the 'soil push' method, whereby the topsoil is removed as 'turf' effectively to keep all the plant and insect diversity intact. They then machine grade the underlying ground and rock and then carefully replace the topsoil. At the same time, they have pioneered the creation of natural seeding to replicate the natural vegetation using the seedling nursery. Whilst expensive at 35€/1kg, the results are far better than any other reseeded which is incredibly difficult at high altitude. The success of this approach is evidenced by the photographs of a recent piste created in the last season, where the author was unable to determine the route of the piste from the summer pictures.

The land for the pistes is mainly owned by the local farmers and they and the lift company enter a contract determining what each party may or may not do in the summer and winter seasons respectively. For example, the pastures are managed organically during the summer; therefore, it is imperative that no chemicals are used during the winter months. They receive an income for this; 2% of the turnover of the lifts, and additional 2% if a lift goes through their land and a further 0.5% if there is a lift station built on their land.

The first piste grooming machines were used in 1965 in Lech. A piste grooming machine lasts for approximately 5000-7000 hours, equating to approximately 5-7 years. They are run on diesel as bio-fuel requires additives in order to work at lower temperatures. Bio-oil is used to ensure that any leakage does not damage the environment. Their efficiency is checked as part of ISO14001 and improves with every new purchase. They are only used when there is sufficient depth of snow in order not to damage the land; this is equivalent to 1m of natural snow (which packs down to 20cm when groomed) or 20cm of artificial snow (which maintains its depth).

The production of artificial snow is dependent on electricity, water and cold temperatures. The snow machines in Lech, as with the lifts, are run off hydroelectricity. Lech does not suffer from a shortage of water. There are two reservoirs in the mountains above the village which provide water for snowmaking in winter and fire prevention in the summer. The construction of the reservoirs required the same impact analysis as for a piste or ski lift and required that they were blended well into the environment. This is evident since the reservoirs are shown in the summer brochures as sights on walking routes. Siting the reservoirs up the mountain means that the use of gravity will lessen the energy required to make the snow. Additionally, some water is taken from the river. This has been studied in order to set the amount that will have no impact on the watercourse or the biodiversity of the river - 290l/s - this is then filtered so it is completely pure before use for snowmaking, in order not to add extra nutrients to the soil.

500 000 m³ of artificial snow has been found to be the amount needed to 'guarantee' good snow coverage for the season. Good snow coverage, as well as making for good skiing, protects the land from skis and piste grooming machines. It is generally made whenever possible and early in the season if possible; it is allowed from the 20th October. By making the artificial snow earlier it has less of an impact on snowmelt later in the season. Indeed it is argued by the Skilifte Lech that making the snow early in the season protects the delicate plants from autumn frosts (in the same way that plants are covered with plastic to protect them). The energy saved by the plants in the autumn and during the cold spring nights when they still have a snow covering, means that they have more energy to flower at the same time and in the same abundance as normal. Indeed, Lech promotes its wild flower display as a key time to visit, thus no negative impacts have been found.

Continual tests are made in Lech measuring the efficiency of snow making machines; there are a variety of methods each working at different temperatures and efficiencies. Compressed air guns at ground level are the most expensive and work at zero degrees, fan guns are mid-priced and work at minus three degrees and the cheapest are the tall guns (giraffe) high above the ground which work at minus five degrees. Thus the colder the temperature, the cheaper it is to make snow. Lech is currently taking part in research to investigate a new snowmaking product which uses a naturally occurring bacterial catalyst to enable the water to be turned to ice at higher temperatures; this would of course save money but would also save energy.

5.2.3 Skier and Activity Management

There is a theoretical uphill capacity of the lifts and a practical one. Piste capacity is calculated based on intermediate skiers proceeding down a red run at an average speed of 4km/h. In Lech a 'factor' value of 15 is used, thus if the uphill capacity is 1500, this is divided by 15 to equal 100. Thus the width of the pistes descending from the top of a lift is optimally 100m. Dividing this value by 2 gives an absolute minimum value of 50m width. It is notable that in Lech the factor is 15 placing a priority on giving space to skiers. In comparison, in eastern Austria the factor used is 30 and in Japan it is 100, there is a much higher tolerance of crowding in Japan. Therefore, the whole ski area of Lech has been planned in this way with the lifts and pistes matched to give a quality experience. In addition, there is a maximum set for the number of ski passes for sale on any given day. When a skier uses the lift pass for the first time each day, it is registered. When 14,000 have been registered, no more tickets will be available for sale. This is publicised on the main approach roads, on the resort website and on the local radio stations. This is, in fact, more related to the car parking spaces available rather than piste congestion since the pistes have been planned using the

aforementioned formula and could comfortably cope with another 2000 skiers. Nonetheless it is maintaining the number of skiers at a level that both the village and pistes can cope with.

The pistes are very clearly marked so that a skier knows clearly where the edges of the piste are, what piste they are on and what level it is and also the way to the nearest lift or restaurant. Environmental protection areas (mainly forests) are signposted and fenced off in places. These areas are also clearly marked on the piste map. The signs do not detail why the areas are important. Interestingly they place responsibility and 'ownership' on the skier; the sign states "Remember – it's your forest". The pistes are patrolled and anyone disobeying the signs will be reported and have their lift pass removed – though the skier would be unaware that this penalty exists – there is no notification on the signs or piste map. Some open terrain is closed off with fencing for safety reasons. Signs prevail around the edge of the ski area, to inform skiers when they are leaving the terrain that is patrolled.

Lech has a large percentage of 'ski routes', which are routes down the mountain that are avalanche secured and signposted, but there is no artificial snow and they are never groomed. They are signposted differently to the pistes to identify them clearly to skiers, the posts mark the centre line and they are avalanche secured for 10m either side. This fulfils many skiers' desire for natural un-groomed "off-piste" snow and ensures that those skiers will be safe from avalanches and will, in turn, not cause any.

Going off-piste and off the ski routes is the responsibility of the skier themselves. Off-piste tends to be self regulating such that skiers only seek to go off-piste when the snow is deep enough in order not to damage their skis and themselves. Therefore, if it is that deep enough then the vegetation does not suffer. Additionally, the number of days in the season when the snow off the piste is of good enough quality is minimal and the number of skiers proficient enough to go off-piste is also low.

Heli-skiing is offered but only in a remote valley aptly called Snow Valley. It has been monitored that there is no game in the area because the snow becomes too deep, thus it is perfect for skiers seeking an extra thrill and does not impact the movements or grazing of the local game - red and roe deer and chamois. Game levels throughout the mountains surrounding Lech are carefully monitored in order to maintain the correct balance - a cull of 120 red deer is necessary each year. There are areas of the mountain purely set aside for game where no skiing in winter or walking in summer or shooting occurs – 'safe' zones for the game.

There is currently no night skiing in Lech but it is under investigation and permission from the local government would be required. Lighting is obviously required and whether this can be attached to existing lift pylons or would require new pylons would be a key factor in the decision making. Another concern is whether the lighting can be configured to not cause widespread light pollution and not disturb wildlife. It is arguable whether there is strong demand for this in a resort like Lech that attracts longer stay customers rather than a strong weekend trade.

Noise pollution laws are very strict in Austrian and are clearly abided by in Lech. These laws are applicable for music on the piste, mountain bars and restaurants, village bars and restaurants, snow machines, piste grooming machines and lift operations.

5.2.4 The Seedling Nursery and Guest Forest

As mentioned earlier, no trees were cut when creating pistes, thus no reforestation was required. Nonetheless, a nursery was developed to grow indigenous trees which are replanted in amongst the mature trees to keep a variety of age trees in the forest, or used to reforest where trees fall over, either naturally or due to avalanche. They have also been planted proactively to protect against avalanches and to stabilise areas and for flood defences. A variety of species are grown - spruce, larch, Swiss stone pine, white fir, dwarf pine, maple, rowan and willow - and a total of 5,738 trees were planted in a single year.

The Lech Guest Forest is an attraction whereby guests may plant their own tree. The trees come from the seedling nursery and are numbered and tagged. A guest may select a tree, plant it themselves and receive a certificate and can see how their tree is growing over the years. More than 4,000 trees have been planted in this way over the last 10 years. This is naturally only possible in the summer months but helps to link guests and their hosts in the stewardship of the natural environment.