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1 The goal of ecological restoration techniques is to return an area's ecosystems to their former condition following deterioration caused generally by development and construction work. Thus ecological engineering techniques[1] are used in a somewhat paradoxical project to remedy the negative effects of technical intervention in the landscape by carrying out further intervention. Indeed, there is an "apparently contradictory association between artificialisation procedures and a demand for authenticity (translation)" (Fabiani, 1995, p. 84). Human intervention in the natural landscape in the name of conservation or management has thus often been discussed from an ethical viewpoint (Génot, 2003; Parizeau, 2006; Blandin, 2009). However, there have been few studies that have empirically analysed the conditions for the implementation of restoration techniques. And yet, as with every technical undertaking (Vinck, 1999), it is important to examine the decisions and adjustments that actors are called upon to make in the real world rather than assuming that the technical project "imposes" a predetermined path producing systematic results. Several empirical studies have been conducted on restoration operations in different environments, both aquatic and terrestrial (Barthélémy and Souchon, 2009; Gonzalo-Turpin, 2008; Trivelly, 2004), which endeavour to analyse the perceptions of local actors, the acceptability of restoration initiatives, and the conditions of their "governance".

2 Based on a survey conducted in Alpe d'Huez, we present a diachronic empirical analysis of the changes that have taken place in a restoration procedure, the revegetation of the ski runs, in a type of environment characterised by a high degree of anthropization and "technicization". The empirical nature of the study enabled us to analyse the specific objectives and techniques that have been adopted in Alpe d'Huez since the first operations to restore the plant cover in the 1970s and 1980s. Thus we were able to recreate the way in which farmers, resort managers, technicians and researchers have

shaped the objectives and stakes in the specific area of Huez. We will endeavour to show how the revegetation programme stemmed from an objective that was first of all technical, that of stabilising the soils (to combat erosion), before very quickly taking on a landscape aspect (regreening), and then becoming a much more complex project combining the restoration of ecosystems and the restoration of a "typical" cultural landscape. These changes were marked by an increasing preoccupation with autochthony in its different forms.

3 We conducted 10 semi-directive interviews[2] with the resort's managers and technicians, farmers (shepherds, stock-breeders, officials of agricultural institutions) and researchers from the Cemagref (French environmental science and technology research institute). These interviews were completed by two observation sessions as well as an examination of different technical and scientific reports. This survey is part of a multidisciplinary project involving ecologists and sociologists from the Cemagref of Grenoble[3].

4 We will begin by reviewing the context and the objectives of the first revegetation operations carried out in Alpe d'Huez in the 1970s. We will then identify the shifts towards ecological and cultural restoration objectives as well as the development of an increasing desire for autochthony. Finally, we will return to the current debate surrounding implementation of the programme in this area, before discussing, in the conclusion, the specificity of our results and their applicability to other alpine resorts.

Regreening and "repairing" the landscape: the introduction of revegetation in a multifunctional area

A legal obligation

5 At the end of the 19th century, the village of Alpe d'Huez experienced substantial rural depopulation - the population fell from 474 inhabitants in 1872 (the maximum ever reached) to 210 in 1931 (Bourreau, 1989). This exodus was halted by the development of tourism. With the construction of the road, completed in 1936, the hamlet of Alpe d'Huez gradually became transformed into a ski resort. From the 1950s, the ski resort earned an international reputation: the Tour de France chose the village as a stage stop, a two-level cable car was installed, and a bob sleigh run was constructed for the World championships and the Olympic Games. In the 1960s, the resort began to offer summer activities with a view to promoting summer tourism: hiking, swimming, fishing in the mountain lakes, horseback riding (Ogier, 1962).

6 This development of tourism involved extensive earthworks and installations and provided a ski area with close to 220 km of runs. Following the avalanche of 1970 in Val d'Isère, which underlined the dangers of unregulated urban development in mountain areas, the Nature protection law of 1976 established the environment as a public good. From 1977, the government directive on mountain areas was aimed at regulating the impact of works conducted for the development of skiing as well as those linked with the arrival of mechanised summer sports (motocross, ATVs). This directive, focussing on the autonomy of the development of mountain communities and on environmental protection, introduced a new planning regulation (the "Unité Touristique Nouvelle") making it obligatory to conduct impact studies in the context of tourism development in mountain areas (Perret, 1994). On January 9 1985, the Mountain Act extended the

directive and made it more specific: any new development works were to be accompanied by measures to rehabilitate mountain pastures. This regulatory context thus introduced a legal obligation to make provision for the revegetation of land on which earthworks have been carried out (Photos 1 and 2).

Repairing the damaged landscape

7 The cost of implementing the revegetation programme was born by the SATA (Société d'Aménagement Touristique), the public-private partnership responsible for managing tourism development in Alpe d'Huez. As well as being a legal obligation, the programme also satisfied a number of resort needs: stabilisation of slopes, opening of ski runs earlier in the season, and a reduction in the impact of development works on the landscape.

8 Works carried out in the resort to create or extend ski runs and to install infrastructures accelerated the process of natural erosion and increased the risks of landslides from slope instability. Soil conservation is a prime objective of resort managers. Revegetation also makes it easier to maintain and stabilise the snow cover: a ski run over a herbaceous cover can be opened before a run over an area that has not been revegetated. In addition, the amount of snow required to maintain the snow cover on terrain where the plant cover has been restored is half that required on terrain that has not been revegetated (20 cm as opposed to 40 cm).

9 Finally, restoration of the plant cover provides a more aesthetic landscape. Improving the image of the resort became all the more necessary with the decision to develop summer activities: it is important that the resort does not appear disfigured once the snow has melted (photo 3).

10 Revegetation can thus be seen as a form of terrain rehabilitation (relative), rehabilitation that is not only technical (combating soil erosion is the prime motive) but also visual. The terms "regreening" and "grass seeding"[4] were often used in 1980s and 1990s:

> "Each time a worksite is completed, we follow up by regreening the area. And since 1985, we've been regreening the runs [...] – we're the guys for reseeding! (translation)"[5]

11 Admittedly, there are limits to this rehabilitation operation since the layout of the ski runs and changes made to the relief can still be seen in summer. However, as one of the scientists involved in operations remarked, at least the landscape has been "repainted" green.

From repairing the damaged landscape to ecological restoration: the desire for autochthony

12 Government scientific and technical services did a lot to make revegetation an ecological restoration project. The idea of ecological restoration was also encouraged within the community by planners who wanted to restore an image of the resort that was closer to its past by basing it mainly on a cultural restoration project centred on pastoral farming.

Ecological restoration and autochthonous plants

13 From the end of the 1970s, the technical division of the Ministry of Agriculture responsible for protection against erosion – which would become the Cemagref in 1985 – launched a number of different revegetation experiments with a view to helping ski resorts. The study was conducted as part of a project entitled "Pastoral farming and revegetation" and in many ways heralded the technical support that has now been provided by the Cemagref to the resort of Alpe d'Huez for some thirty years. For the scientists involved, the project was rapidly reformulated from being a project to reconstitute eroded terrain to an ecological restoration project. When the organisation acquired the status of a public scientific and technical establishment (Etablissement Public à Caractère Scientifique et Technique) in 1985, it reoriented its activities towards scientific research. The techniques developed by the ecologists then became less focussed on repairing the scars on the landscape and more on restoring the "natural" mechanisms: "*we realised that in practising revegetation, we were setting up spontaneous processes, natural processes (translation)*". The organisation acted quickly to "rehabilitate areas at altitude that had undergone development works, no longer simply regreening them (translation)" (Dinger, 1992).

14 Because local plant species are adapted to conditions at altitude, and through fear of seeing introduced species become uncontrollable, researchers quickly sought to encourage the reconstitution of plant groups that existed naturally, by limiting the artificial components of planting programmes. From the 1980s, indigenous seeds were introduced in the mixtures used. But the desire to promote autochthony was sometimes pushed even further: thus, the introduction into the natural milieu of seeds of plant populations cultivated in the valleys, even if the species were present locally, was considered to run the "*risk of losing really local characteristics*" through genetic pollution (crossbreeding with local plants). Researchers therefore tried to favour the spontaneous recolonisation by local plants by decreasing the doses of seedlings (Dinger, 2004). A scientific research group "Native seeds" was also set up in the 1990s. However, the project did not last long in the Alps on account of technical and financial reasons[6].

15 Research studies were also conducted on the substratum, the layer of earth that governs plant growth. An experiment was carried out in which sheep manure was spread by stock rearers to revegetate the old bobsleigh run. Thus it involved using local materials (or at

least from the surrounding area) and was conducted in an autonomous manner by local farmers.

16 Finally, the ecologists involved have more recently been reflecting on the possibility of enlisting domestic herds to optimise the return of the plant cover, making the animals "ecosystem engineers", capable of affecting the functioning of the ecosystem by modifying the physical and chemical structures of the milieu (Jones et al. 1994). Indeed, according to recent studies, conducted for the most part at the Cemagref, the passage of herds would encourage the building up of a store of seeds in the soil namely through the trapping of seeds in the imprints left by animal hoofs (Isselin-Nondedeu, 2005). Grazing would also stimulate both the micro-organism activity in the soil and the nitrogen cycle - cow dung and sheep droppings provide a dose of nitrogen that acts as a natural fertilizer -, favouring the recovery of vegetation on even relatively infertile land (though this may also result in a certain uniformisation of the flora). The "Pastoral farming and revegetation" project is thus aimed at evaluating the effects of the presence of herds (load and date of passage) on the recovery of the soil and on plant diversity, and at determining to what extent it could favour the return of autochthonous plants.

17 The above results concur with those of sociological analyses concerning operations to re-introduce animals in protected areas, which reveal increasing justification for re-introductions based on their autochthony – excluding the introduction of "new" animals (Mauz, 2006). They also confirm the results of the analysis of efforts to combat the invasion of exogenous plants (Rémy and Beck, 2008): underlying the desire to get rid of the organisms in question, scientific logic and moral considerations appear interwoven in a close and potentially concerning manner.

A cultural restoration project around pastoral farming

18 From the beginning of the 1980s, when revegetation programmes were being set up, ski resort managers encouraged the return of cattle grazing in the summer. Indeed, from the 1930s farming activities had experienced a substantial decline in favour of tourism development. In the 1980s, even though the great transhumance of sheep had continued, there was only one cattle rearer left and seven animals, while at the beginning of the 20th century there were 200 cattle grazing on the communal lands. At the moment, encouraged by national incentives[7], the locally elected representatives want to relaunch cattle farming in order to maintain the land. The commune has created a pastoral land association (group of landowners, public and private, aimed at ensuring soil recovery) as well as a pastoral farming group of stock-breeders whose aim is to ensure common management of the herds. The return of cattle grazing appeared important for the ski resort from an image point of view.

19 In this context, efforts were made to harmonise revegetation with pastoral farming activities through reciprocal adjustments and technical adaptations. Thus the restoration of the plant cover is *a priori* beneficial from the point of view of pastoral farming activities since it re-establishes pasturelands that had been lost following earthworks. In certain cases, it can even lead to an increase in pasture zones thanks to the use of compost on zones that had never had a plant cover before the construction works. The appetence of the plants for the herds was progressively taken into account and led to a slight modification of the mixture used to eliminate certain non-edible species. The presence of

the animals is in fact supposed to favour growth of a good herbaceous cover and more diversified vegetation (cf. above). However, the shepherds have to allow the terrain a period of two or three years of adjustment, for the soil to become more stable and the plants less fragile[8].

20 Today, pastoral farming tends to be no longer considered simply as a means of maintaining pastures but also as a real tourist attraction, even though in this there may be tendency to treat the activity as part of local folklore: it is no longer appreciated for its productive aspect but more for its ties with old customs and recreating a traditional atmosphere. The commune has supported a project by a shepherd to set up a local cheese production activity. The sheep barn has been renovated – and decorated with a life-size painting of a cow on the front wall – in an effort to attract visitors to come and watch a milking session (photo 4). Currently, the commune is considering a project to run a year-round farm. With a few milking cows at Huez, in summer and winter, this farm would promote the image of a living mountain community, a little more in line with the picture postcard image that tourists have; "the image of the shepherd with his cape", as one of the resort managers puts it.

Debates and criticism

21 For some people, namely SATA members, the revegetation operations require the consensual motivation of all the actors involved:

> "Pastoral farming and revegetation activities go together; it's a family, or group, that works around all that. It's the will ... a deliberate choice of the commune, the elected representatives, the SATA, of everybody...(translation)."

22 Revegetation operations, however, have been criticised over whether they really do produce environmental benefits – for example, over the consumption of energy that they entail:

> « It's true that the landscape is prettier, but then you have to take everything else into account to see if it can be justified from an ecological point of view, because replanting whole sectors takes a lot of energy. If you have to consume an enormous quantity of fuel to set up machines that are going to break up rocks, and then send up truckloads of earth just to get a few tons of grass to feed the animals ..... (translation)."

23 One important criticism concerns the potentially harmful effects of compost. The compost used at Alpe d'Huez is in fact obtained from the sludge of the Bourg d'Oisans purification plant, in an effort to contribute to sustainable development through the " *intelligent re-use of waste*", to quote one of the SATA officials. However, stock-breeders are somewhat fearful that animals put to graze on pastures enriched by such compost may be exposed to health risks:

> "Generally the sludge is treated, so that it is not normally harmful for the animals, but who knows? It's not something we're too happy about. There was some discussion, but there was no real assurance given about using the sludge. But the question has been raised...(translation)."

24 Those actors who have reservations about the compost are in favour of technical alternatives, such as the use of wood chippings or animal droppings.

25 Nor is it only the techniques of revegetation that are being criticised. The very principles of compensation and repairing damage to the landscape are also being questioned. A member of the farming community points out that in actual fact there should be no need for environmental debate around revegetation since it is only a compensatory measure made necessary by the earthworks carried out:

> "Now, in fact, they (the resort managers) are always keen to make this point, saying "Do you realise that we do put back the grass?" But , of course, if they hadn't started digging in the first place, there wouldn't have been any need to put the grass back! (translation)."

26 The fact that there exists a process providing for the relative rehabilitation of land disturbed by earthworks seems to legitimise the act of carrying out the work. There is thus a potentially perverse effect. Similarly, questions could be raised over the recent project to reconstitute the substratum to encourage plant growth on sites situated at an altitude of 2700 metres (at the exit from the cable car station), an altitude at which plants do not normally grow. Even if it's a question of "*lending Nature a helping hand*", as suggested in one of the surveys, does this not represent an important change in the project objectives, with a shift from the restoration to the re-creation of a natural landscape – for recreational purposes (Fabiani, 1995, p. 90)?

Conclusion

27 For Fabiani, "any restoration project is inseparable from a policy concerning the natural environment" (Fabiani, 1995, p. 90). The aim of this study has been to try to understand the specific terms of the natural environment policy that has been followed for some thirty years in Alpe d'Huez with regard to revegetation. This diachronic reconstitution has enabled us to identify the debates surrounding both specific technical choices (compost) and the perverse effects of the provisions made for "repairing" the terrain disturbed by earthworks. Revegetation operations are far from meeting universal approval. The study has also enabled us to identify the passage, since the 1970s, from an objective of repairing the scars left on the landscape by works relating to tourism

development to a far more complex undertaking of restoration structured around a desire for autochthony (see Table 1). This is reflected not only in different innovative techniques aimed at restoring "natural" ecosystems, but also in the cultural restoration of the place of pastoral farming in the area.

28 This result is admittedly not new in the debate on how to define the objectives or the benchmark for what is considered "good restoration" by the ecologists (Van Diggelen et al,2001; Donadieu, 2002). From the 1990s, some observers have called for a change towards forms of ecosocietal or ecocultural restoration: Higgs (1997) thus considers that restoration involves an ethical dimension just as much as a technical one, which should be taken into account alongside the search for ecological integrity (and that therefore differentiates restoration from ecological engineering).

29 The transition in policy from a technical and landscape objective to a more complex restoration objective, along with an increasing concern for autochthony, can also be observed in other major alpine resorts. However, certain debates and issues appear specific to Alpe d'Huez. The physical characteristics of the resort area – relatively steep slopes implying a fairly high erosion risk - and the staging of the Tour de France through the resort have contributed to the systematic organisation of revegetation techniques. Moreover, the history of pastoral farming in this resort, which bears witness to a particularly marked revival in the 1980s, has led administrators and researchers alike to try to make use of pastoral farming practices and to involve the herds in the revegetation programme. An area's physical characteristics, its history and its configuration of actors thus play a role in programme implementation. Unlike the resort of Alpe d'Huez, the resort of Les Saisies thus chose (with the impetus of the Office National des Forêts) not to replant the cross-country ski trails but to let the vegetation recover by itself, given that erosion risks are not very high and that there is a special type of plant formation in this area (peat bog). The resort of Val Thorens, because of the large number of water catchments in the area and the important role of the Lyonnaise des Eaux, chose to not use compost and instead to implement an original technique based on wheat seeds to prepare the ground.

30 Similar studies should therefore be conducted in other ski resorts - and in other countries of the Alpine arc – to trace the different histories and specific issues of revegetation in these areas with a view to comparing the different revegetation policies adopted in the Alps.

Table 1: The different methods of revegetation

Note: This table categorizes the different types of intervention identified in the study, even though some of these are used simultaneously.

Type of intervention	Rehabilitation	Re-greening	Ecological restoration	Cultural restoration
Subject	Soils	Landscape	Ecosystems	Professional practices
Principle	Restore condition of soils after earthworks for development	Restore plant cover to enhance landscape	Return ecological system to satisfactory state	Enable traditional practices to continue
Objectives	- Combat erosion - Create favourable conditions for skiing	- Enhance landscape aesthetics - Create favourable conditions for tourism	Combine management support and ecological research	- Conserve heritage - Create favourable conditions for tourism
Means	Re-grassing	Re-grassing	- Native seeds - Herds used as "ecosystem engineers"	Support for stock-rearing activities

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NOTES

1. Ecological engineering is aimed at maintaining or enhancing a given ecosystem process and, as a result, the goods and services that it provides, by restricting any intervention in the ecosystem to a minimum (Gosselin, 2004).
2. The field survey was conducted in the summer of 2009, during an internship at the Cemagref, Grenoble (Chanteloup L., 2009).
3. This project was financed by the CNRS and Cemagref interdisciplinary Ecological engineering programme, in 2009-2010, and was entitled "La revégétalisation des pistes de ski: retour sur expérience à l'Alpe d'Huez en vue d'une utilisation des bovins et ovins comme espèces ingénieurs des écosystèmes herbacés dégradés, favorisant le retour d'une végétation autochtone sur les pistes de ski après travaux"
4. This term is still used today by certain actors, particularly by technical personnel in revegetation programmes.
5. We prefer to maintain maximum anonymity for the extracts of interviews cited, given that the survey was conducted within the limited context of an identified commune.
6. A local branch is being developed in the Pyrenees.
7. In 1985, the Mountain Act (la Loi Montagne) created a tax on ski lifts in order to promote agriculture (art. 89).

8. Straw is spread over the entire grassed area in order to protect the seeds from the effects of heat but also to protect them trampling.

ABSTRACTS

The study adopts an empirical sociological approach to analyse how the objectives behind the revegetation of ski trails and runs in the French alpine resort of Alpe d'Huez have evolved since the 1970s. A revegetation programme was first introduced to repair the scars left by the works conducted to equip the resort with infrastructures, and then, over time, it became a more complex restoration project. At first, revegetation techniques were developed to fight soil erosion, but soon also became associated with the idea of "turning the mountain green again". Now, 40 years later, revegetation is aimed at restoring both a natural ecosystem and a cultural landscape. The ski resort's managers, local farmers, technicians, and those conducting research in the area share a common desire to promote autochthony, which in some cases runs the risk of reproducing folklore. Far from adopting an overriding ethical perspective, the study suggests that the area's physical characteristics, specific history and configuration of local actors have shaped and continue to shape both the manner in which ecological restoration is implemented, through political choices and technical decisions, and the debates it gives rise to. The study concludes by examining the specificity of the findings for Alpe d'Huez and discussing their validity for other alpine ski resorts.

A partir d'une approche sociologique empirique, ce texte propose une analyse de la mise en œuvre de la revégétalisation sur la station de l'Alpe d'Huez depuis les années 1970. Il montre comment la revégétalisation est passée d'un objectif de réparation des cicatrices provoquées par les aménagements à une entreprise plus complexe de restauration. S'il s'agissait au départ de répondre à un objectif technique de lutte contre l'érosion, la revégétalisation a pris rapidement une tournure paysagère (reverdissement) ; elle a ensuite été pensée dans une perspective de restauration des écosystèmes ainsi que de restauration d'un paysage culturel « typique ». Aujourd'hui, gestionnaires de la station, techniciens, agriculteurs et chercheurs impliqués partagent un désir d'autochtonie qui touche dans certains cas à la foklorisation. Loin d'une perspective éthique surplombante, cette étude suggère ainsi comment les caractéristiques physiques du territoire, son histoire et la configuration des acteurs locaux informent largement les arbitrages et les choix techniques qui président à la restauration écologique, ainsi que les débats qui l'entourent. En conclusion, nous discutons de la spécificité de nos résultats et de leur validité pour d'autres stations alpines.

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Mots-clés: Alpes, restauration écologique, revégétalisation, station de ski
Keywords: Alps, ecological restoration, revegetation, ski resort

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