Tourism in the Verdon catchment

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Abstract

The main goal of this study was to estimate the vulnerability of the tourism sector in the Verdon catchment. The main drivers of change were identified and the sensitivity of this sector to these changes assessed. Then we explored how to develop tourism sustainably safeguarding local livelihoods and biodiversity.

In any scenario, our study region is likely to face water shortages as the main problem in the future. Our analysis suggests that the present policy of "hors circuit, hors saison" probably will remain the key strategy for improving sustainability in the tourism sector. Furthermore, we recommend strengthening the links between tourism and other sectors, especially cooperation with agriculture.

Introduction

Featuring Europe's largest canyon, the Verdon catchment area is situated in one of the most picturesque areas of the Alpes de Haute Provence, attracting 1.5 million tourists each year. Among the main tourist attractions in the Verdon catchment are the Gorges du Verdon, five artificial reservoir lakes, and the extensive lavender fields on the plateau. The tourism sector in the Verdon catchment is economically important, e.g. for employment (2000 permanent jobs, 1500 seasonal (mainly July and August); Présidy & Hauwuy 2004) and revenue generation. Most tourists visit the area during July and August. Three out of five tourists are French, and half of these live in the region itself. The other tourists come mainly from the Germany, Netherlands and Belgium. For an introduction into the history of tourism in the Verdon catchment see Appendix 1.

Along with the scenic nature including the gorge, cultural landscapes, water sports opportunities and a relatively reliable sunny weather, the Verdon catchment offers breathtaking bird-watching opportunities, for instance for the canyon's vulture colony (*Gyps fulvus*, and the reintroduced *Gypaetus barbatus*). The main tourism activities in the Verdon catchment include wine and food tours, visiting farmers' markets, water sports (e.g. swimming, white-water sport, kayaking, canoeing, and other forms of boating, hydrospeeding or hot-dogging (similar to white water rafting but in a smaller raft, see e.g. Blackmountain Activities Ltd. 2009 for further explanation), cycling and motor-biking, and downhill and cross-country skiing. For a complete list of activities see Appendix 2.

One of the main regional problems is water shortage, which can cause conflicts with electricity suppliers (hydropower), local farmers, and local inhabitants. But seasonally high numbers of tourists, especially in the Gorges du Verdon, require that the hydrologic regime of the river to be controlled. Abrupt changes in water levels due to the operation of hydroelectric power stations can compromise conservation goals, related e.g. to freshwater diversity downstream or vulture breeding. Increased traffic on transit routes as well as on roads mainly used by residents causes noise and pollution.

Methods

We followed the approach of a regional vulnerability assessment as outlined in the general methods chapter provided by the synthesis group (see overall introduction for further explanation) based on literature review and expert judgments. Important to note is that the (traditional) concept of vulnerability is applied in a wider sense here and does not only encompass the natural environment, but

also social processes and phenomena. This is an advancement of the concept and terminology recently developed and discussed in the scientific community (see, e.g., Adger et al., 2004). The information gained from interviews with key stakeholders was incorporated into the estimation of vulnerability of different tourism activities. For each activity we identified the dependence on various ecosystem services (Appendix 3) and how these services are affected by tourism (Appendix 4). Vulnerability of the four main touristic activities was characterized by three crucial elements, i.e. i) exposure to drivers of change, ii) sensitivity, indicating the susceptibility to the respective driver; and iii) adaptive capacity. The analysis was carried out for two scenarios, the Global orchestration scenario (GOS) and the Adaptive Mosaic scenario (AMS) (for further information see scenario reports from the Millennium Ecosystem Assessment 2005). For an illustration of the possible future paths see Appendix 5.

Results

As most of the tourist activities relate to the landscapes' harmonic ensemble, a future change in land use was identified as a main driver of change in the region, followed by climate change and economy (Fig. 1). Additionally, the tourism activities most strongly affected by land use change contribute to the largest proportion of revenues from the tourism sector. The four economically most important tourism activities are skiing, water sports, cycling/ motor biking and culinary tourism. In the following, we will focus on these four main tourism activities and the three drivers mentioned.

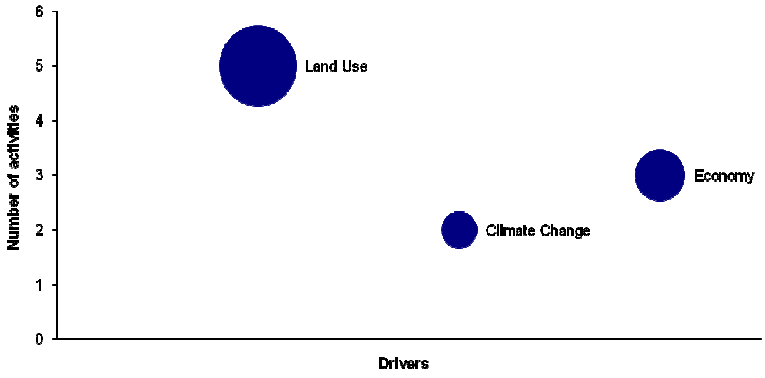


Fig. 1: Main drivers of the 14 identified tourism activities in the Verdon catchment. The size of the circles represents the aggregated economic importance of the respective activities.

Development possibilities and vulnerability of skiing activities

Two main winter sport areas are located in the Verdon catchment: La Foux and Le Seignus, both in the Allos valley (Appendix 6). Winter tourism especially skiing is economically important in the Verdon catchment (Appendix 2), and ski areas in the Alps in general are expected to be strongly affected by climate change (Abegg, 2007).

The ski areas are particularly **exposed** to temperature rise influencing snow reliability (i.e. sufficient snow cover for over 100 days of skiing) depending on the altitude (**sensitivity**). Currently, snow cover is naturally reliable at about 1500 m in the Southern Alps. However, this altitude is likely to rise by 150 m for each degree of temperature rise. Hence, the lower ranges of the Verdon ski areas, at 1500 m and 1800 m, could be threatened by the expected **exposure** that temperature rise represents. Both scenarios (GOS and AMS) suggest a global temperature rise of 2°C by 2050. The **impact** of climate change is therefore considered to be high. Nevertheless, the maximum altitudes of 2400 m for La Foux and 2675 m for Le Seignus suggest that the system has

some management options (**adaptive capacity)**. Even for a relatively strong warming scenario, some ski runs will remain in areas with reliable snow cover, where winter tourists would then aggregate. The system's overall **vulnerability** is therefore considered to be relatively high.
Due to large energy consumption and high demand for water, snow machines do not represent adequate **adaptation options**. An expansion of ski runs towards higher altitudes is often limited by topographical features and small total surface areas at higher altitudes. Moreover, skiing at high altitudes might negatively affect sensitive mountain ecosystems. Apart from an optimal management of the existing skiing infrastructure, adaptation options regarding this winter sport are strongly limited. A shift to activities demanding less snow, like sliding or cross-country skiing, however may constitute a viable option for the next years to decades.

Development possibilities and vulnerability of water tourism activities

Water tourism activities (e.g. kayaking/canoeing, swimming, boating) are carried out mainly in the reservoir lakes of the Verdon and in the Verdon river itself.
The Rhone and its tributary, the Verdon, are highly dependent on snow and glacier water. Glacier retreat and snowfall decrease in the past decades suggests that climate change affects the river flow by decreasing water availability, especially in summer. Additionally, water use by the agriculture, energy and industry sectors (EEA, 2009), as well as an increase in evaporation of the lakes due to warming are expected to aggravate this flow situation. However, for both scenarios, the climatic conditions ensuring a physiological comfort for humans in summer are expected to improve (EEA, 2008).
Given an annually occurring water shortage for the GOS, the **exposure** can be considered to be medium. Under the AMS, however, with water shortages occurring only every few years and an integrated water management system, the exposure is reduced to a lower level.
A relatively high **sensitivity** of artificial dams towards changes in physical parameters and water flow regulation (e.g. Moreno-Ostos et al. 2008; Goosseff et al. 2005) suggest a relatively high **impact** of climatic changes on reservoirs for the GOS. This could affect water levels and water quality (decrease in dilution of pollution, increase in algae due to higher water temperatures) negatively affecting water sport activities. For the AMS, the impact is considered to be lower.
Water flow regulation is an important part of the **adaptive capacity** by ensuring sufficient water levels in summer to maintain tourism activities. This management option is very limited in the GOS.
The overall **vulnerability** of the water sport activities is estimated to be high for the GOS and medium for the OMS. **Adaptation** by shifting water sport activities from summer to spring or autumn could reduce the vulnerability.

Development possibilities and vulnerability of motor biking and cycling

Both motor biking and cycling are characterized by a direct dependence on infrastructure; i.e. roads for motor biking and cycling, trails for mountain biking. Socioeconomic changes represent the main driver constituting the **exposure** these activities have to cope with.
Against the background of the GOS, the expansion of the tourism sector is likely to lead to increased traffic, overcrowding and noise. The improved rural infrastructure also implies the spatial spread of tourism into remote regions distant from the large urban centres where tourists originate (Herbert et al. 1982). This development reduces the attractiveness of the region (**sensitivity**). In contrast, under the AMS, the number of foreign and overall visitors is likely to be much lower. In the long run,

the degree of rural infrastructure will be reduced, although existing roads can still be used for at least 50 years. Overall, traffic and overcrowding is substantially lower.
We assume that the economic development via traffic volume and infrastructure has a noticeable **impact** on cycling/motor biking. Still, tourists interested in these activities have some **adaptive capacity** in seeking out less frequented roads or trails. In the AMS, bikers might even appreciate the reduced traffic and noise. In conclusion, the **vulnerability** is considered comparatively low and consequently proactive **adaptation measures** are less important.

Development possibilities and vulnerability of culinary tourism

The location and climate of the Verdon catchment facilitate easy access to natural resources (e.g. necessary for wine-growing) allowing for the production of high quality goods and food. In addition, frequent farmers' markets selling local products make the culinary tourism an attractive opportunity in the area.
Economic development is considered to be the main driver of change (**exposure)**. Changes in the agricultural practice strongly affect the quality of the products and the attributed and crop-related aesthetic value of the landscape influences the reputation of the region. Under the GOS, the range of local agricultural goods is expected to be limited due to changing conditions for production. Nevertheless, high quality wine, cheese and lavender can still be expected to be produced locally, which increases the number of tourists visiting. Thus exposure under this scenario is estimated to be medium. Under the AMS, the landscape is projected to shift towards small scale farming systems with a large variety of local food products. The overall number of tourists visiting the region and their purchasing power will decrease; hence the exposure is also likely to be medium. Culinary tourism is very **sensitive** to changes in the number of tourists and the revenues generated, which depends on the reputation of the region and the quality of the products. Thus, under the GOS, the **impact** is estimated to be low, whereas under the AMS the impact is likely to be larger. The **adaptive capacity** could be larger under the GOS since more liberal trade conditions allow for a better exchange of products and technology, whereas under the AMS, culinary tourism would largely depend on the local infrastructure. Overall, the **vulnerability** of culinary tourism to the described changes is higher under the AMS than under the GOS.
Possible **adaptation options** especially under the GOS could entail a stronger emphasis on marketing of the region. Developing, e.g., a regional agricultural label could increase the visibility of the catchment's touristic activities. Under both scenarios, offering culinary courses and seminars would strengthen the service sector.

Vulnerability summary

Skiing and water sport activities constitute the most vulnerable activities under both future scenarios (Fig. 2). Cycling/ motor biking are considered to be least vulnerable.

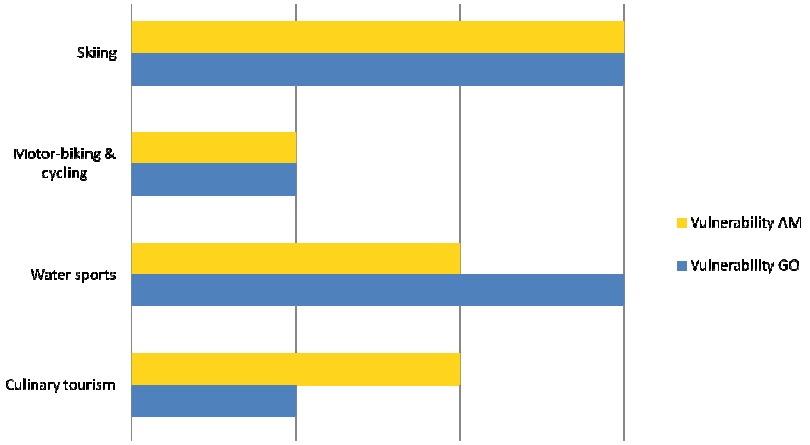


Fig. 2: Vulnerability of the four main tourism activities under the Global Orchestration (GO) and Adaptive Mosaic (AM) scenario.

Overall adaptation options for the tourism sector:

In addition to adaptation measures for the individual tourism activities, we suggest the following general strategies to ensure sustainable tourism in the Verdon catchment, applicable for both scenarios, Global orchestration and Adaptive mosaic:

1. Continuing the "hors circuit, hors saison"-programme.
   - Diverting tourism flow off the main circuits
   - Shifting tourism flows to the off-season by a differentiated pricing system and an improved communication between stakeholders of education and tourism. Furthermore, a decentralized holiday schedule prolonging the national holiday season of the schools could be discussed.
2. Strengthening cooperation between agriculture and tourism, e.g. by agreements regarding postponed lavender harvest to ensure a longer blooming period, highly attractive to tourists.
3. Strengthening the visibility of the region by a coherent tourism concept
4. Strengthening the links between the various tourism activities and other sectors

Discussion and Conclusion

Irrespective of the scenario considered, the main problems of the region in the future are related to water shortages, especially during the peak season when water consumption by tourists is highest. The GOS suggests a severe impact on both quantity and quality of water leading to increased competition for this resource between tourists and local residents, especially farmers. Under the AMS, the effect will be lower due to regionalized or even catchment-based policies and management strategies.

Complete abolishment of subsidies under the GOS will strongly affect land use, as shepherds and farmers are likely to be forced to abandon first their activity and ultimately their land.

Most of the tourism activities in the region depend to a certain degree and impact on biodiversity. Under the GOS the associated negative impacts will be more extreme than under the AMS (Tab. 1).

Table 1: Effect on biodiversity by changes of the four analyzed tourism activities under the GO and AM scenario

Selected tourism activities	Global orchestration	Adaptive Mosaic
Culinary tourism	Ɛ	∅
Water sports	ƐƐ	Ł
Cycling/Motorcycling	Ɛ	Ł
Skiing	ƐƐ	Ɛ
Overall	Ɛ	Ł

Strengthening cooperation is a key prerequisite for coping with future challenges in a sustainable and integrated manner. For instance, to avoid conflicts arising from competition for water, common strategies together with the agricultural sectors need to be developed.

In the context of the vulnerability analysis, culinary tourism and cycling in particular should be strengthened in the region, *inter alia* via extending the season and by offering additional activities. Our results suggest a large potential to expand this economically vital sector in this area.

Ultimately, the level of vulnerability depends on the selected scenario. We therefore recommend continuing the study as well as monitoring the implementation of the presented results.

Literature

Abegg, B., Jetté-Nantel, S., Crick, F., de Montfalcon, A. (2007): "Climate Change in the European Alps: Adapting Winter Tourism and Natural Hazards Management." S. AGRAWALA (Hrsg.). OECD. Paris.

Adger, W.N., Brooks, N., Bentham, G., Agnew, M., Eriksen, S. (2004): New indicators of vulnerability and adaptive capacity. Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia. Technical Report 7

Black Mountain Activities Ltd. (2009)
http://www.blackmountain.co.uk/whitewater/hot%20dogging.htm
[as of October 24 2009]

EEA (2008): Impact on Europe´s changing climate – 2008 indicator based assessment. Joint EEA-JRC-WHO report.

EEA (2009): Regional climate change and adaptation - The Alps facing the challenge of changing water resources, EEA Technical Report, No. 9/2009.

Goosseff N.M., Strzepek K. and Chapra C. S. (2005). Modelling the potential effects of climate change on water temperature downstream of a shallow reservoir, lower Madison River. Mt. Climatic Change, 68, pp. 331-353.

Dilly O., Rogaß C., Doerrie C., Schneider BU., Hüttl RF., Hallenbarter D, Kräuchi N., Imrichová Z., Kenderessy P., Oszlányi J., Putzhuber F., Hasenauer H., Oja T., Kull A., Mander Ü., Moncada S., Camilleri M., Stuczynski T., Korzeniowska R., Siebielec G., Koza P., Lopatka A., Pudelko R., Kowalik M. (2007): Sustainability Issues in European Sensitive Areas Annex 4: European Islands SENSOR Project Deliverable Report 6.1.1, 57 pages.

Kariel H. G. and Kariel P. E. (1982). Socio-Cultural Impacts of Tourism: An Example from the Austria Alps. Geografiska Annaler. Series B, Human Geography, Vol. 64, No.1, pp. 1-16.

Millennium Ecosystem Assessment (2005) Ecosystems and Human Wellbeing: Synthesis Report. World Resources Institute, Washington, DC.

Moreno-Ostos E., Marcé R., Ordoñez J., Dolz J., and Armengol J. (2008). Hydraulic management drives heat budgets and temperature trends in a Mediterranean reservoir. Internat. Rev. Hydrobiol., 93: 131-147.

Office de Tourisme du Val d'Allos (2009). http://www.valdallos.com [as of October 24 2009]

Présidy J. and Hauwuy E. (2004). Schéma du tourisme durable du Parc naturel régional du Verdon. Parc naturel régional du Verdon: Rapport final, Décembre 2004.

Rossi G. Parolo G., & Ulian T. (2009). Human trampling as a threat factor for the conservation of peripheral plant populations. Plant Biosystems, Vol. 143, No. 1, pp. 104-113.

Appendices

Appendix 1: History of tourism in the Verdon catchment

Before dams were built for flow regulation, crossing the Gorges du Verdon was almost impossible. Hence, the establishment of tourism in the region was slow. In 1928, the first hiking trails and scenic viewpoints were established by the Touring Club de France. In 1973, the Route des Crêtes was opened to channel increasing numbers of visitors. The construction of the dams and subsequent flooding began in the 1950s, and ended with fifth and last artificial lake in 1974. Dam construction served a triple purpose then: the generation of electricity, the provision of drinking water reservoirs for Marseille and the coastal areas and the design/engineering of touristically attractive lakes. Today, different lakes fulfil different purposes to avoid conflicts between power generation and the generation of incomes from tourism. Water sports thus added to the already broad range of typical touristic activities in the Verdon catchment. Much later, in 1997, an area of 177,000 ha was protected as Parc Naturel Régional. During the last decades, tourism has substantially increased, as reflected in the construction of water reservoirs and ski lifts.

Appendix 2: Dependence of the various touristic activities on natural, physical, and human factors, financial importance of the touristic activity, its seasonality, threats to biodiversity, and dependence on biodiversity. The touristic activities that are economically most important are depicted in bold face.

Touristic activity	Dependence on natural factors: landscape, species[i]	Dependence on physical factors: snow, rocks[i]	Dependence on human factors: infrastructure, culture[i]	Provenance of participants[k]	Financial importance of activity[j]	Seasonality[l]	Threat to biodiversity[m]	Dependence on biodiversity
Culinary tourism[a]	2	2	3	I	3	Sp, Su, Au, Wi	0	2
Water sports[b]	2	3	1	I	3	Sp, Su, Au	0	2
Motor-biking & cycling	3	2	1	I	3	Sp, Su, Au	0	1
Skiing[c]	3	3	2	I	2	Wi	-	1
Hiking[d]	3	1	1	I	2	Sp, Su, Au	0	2
Wildlife harvesting[e]	3	3	1	R	2	Sp, Su, Au	-	3
Adventure tourism[f]	2	3	1	I	2	Sp, Su, Au	0	1
Sight-seeing[g]	3	3	3	I	2	Sp, Su, Au, Wi	+	3
Nature watching[h]	3	3	1	N	2	Sp, Su, Au, Wi	+	3
Farm stays	2	2	3	I	2	Sp, Su, Au, Wi	0	3
Horse riding	3	1	1	N	1	Sp, Su, Au	0	2
Golfing	1	3	3	R	1	Sp, Su, Au	-	1

Key:
[a]wine and food tours, farmers' markets; [b]swimming, white-water sports, kayaking and other forms of boating; [c]downhill and cross-country; [d]individual and organized, i.e. guided tours; [e](fly-)fishing and hunting; [f]rock climbing, parachuting, gliding, paragliding (in 1993, the Verdon catchment provided the venue for the world championship in paragliding in St André les Alpes); [g]cultural and natural; [h]birds, mammals, plants, and rocks; [i]1: low, 2: medium, 3: high; [k]I: international, N: national, R: regional; [l]Sp: spring, Su: summer, Au: autumn, Wi: winter; [m]0: no effect, -: negative effect (blue), +: positive effect (green).

Appendix 3: Dependence of the four main touristic activities on ecosystem services and effects of the touristic activities on ecosystem services.

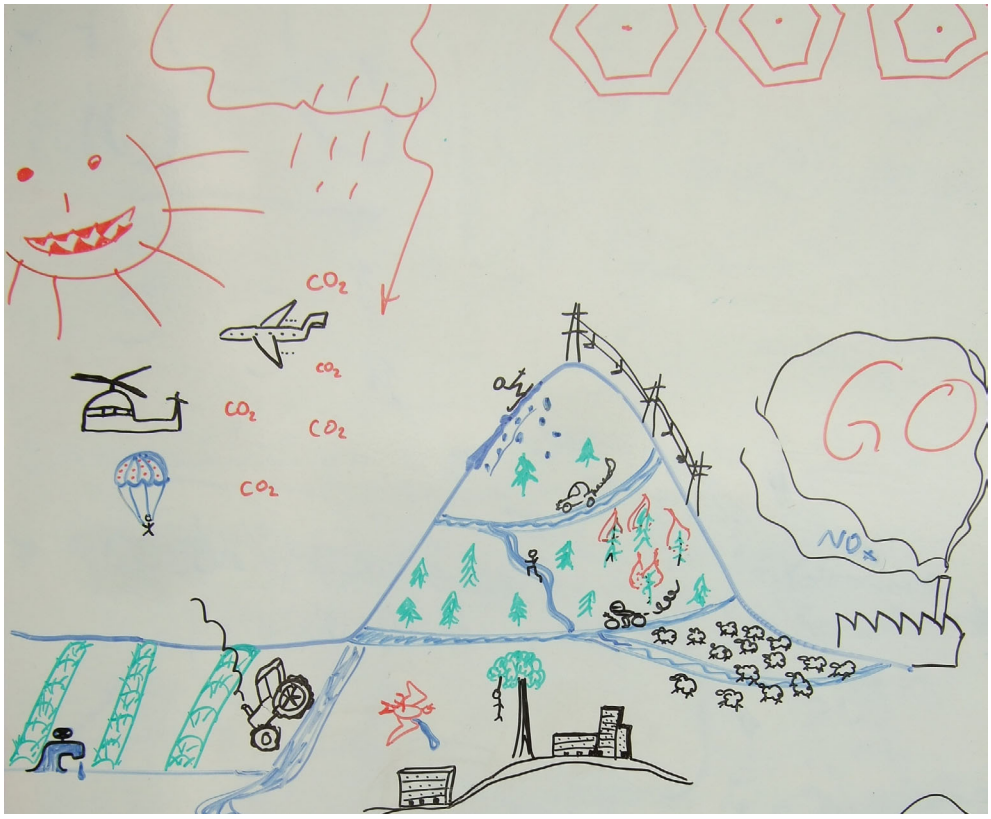
Touristic activity	Ecosystem services[d]	Provisioning services	Cultural services	Supportive services	Regulationg services
Culinary tourism[a]	PrS, CuS, ReS	[Primary production, food production, water provision] water shortage	[Education, recreation, aesthetics] overcrowding, traffic		[Water quality] Pollution
Water sports[b]	PrS, CuS, SuS, ReS	[Primary production, food production, water provision] flow regulation, water shortage, water quality[e]	[Recreation, aesthetics] overcrowding, traffic	Nutrient cycling, sedimentation, erosion, eutrophication	[Water quality, flow regulation] Pollution
Motor-biking & cycling	PrS, CuS, ReS [1]	[Primary production, food production, water provision] water shortage, pollution	[Recreation, aesthetics] overcrowding, traffic, noise		[Erosion control] Erosion, trampling, soil compaction
Skiing[c]	PrS, CuS, SuS, ReS	[Primary production, food production, water provision] water shortage	[Recreation, aesthetics] overcrowding, traffic infrastructure	[Provision of habitat] fragmentation, deforestation, landslides, avalanches [Nutrient cycling] changed nutrient regime[f]	[Erosion control] Erosion, trampling, soil compaction

Key:
[green colour] indicates the ecosystem service(s) the each activity relies on,
red colour the activities' potential effect on the respective ecosystem service;
[a]wine and food tours, farmers' markets; [b]swimming, white-water sports, kayaking and other forms of boating; [c]downhill and cross-country; [d]PrS: provisioning services, CuS: cultural services, SuS: Supportive services, ReS: regulating services; [e]the effects on biodiversity are unclear as regulating water flow may remediate the negative effects of water shortage; [f]nutrient regime altered by nutrients released from artificial snow; [1]Rossi et al. 2009. Note that water shortage due to increased water consumption by high numbers of tourists and increased traffic resulting in pollution, habitat fragmentation due to road construction, and thus the general deterioration of untouched areas for recreation are overarching problems causing the degradation of provisioning and cultural ecosystem services (Herbert et al. 1982, Dilly et al. 2007).

Appendix 4: Changes in tourism dependent ecosystem services under the GOS and AMS (upwards directed arrows indicate positive changes, downwards directed arrows negative changes and horizontal arrows no changes)

Scenario	Global orchestration	Adaptive mosaic
Provisioning services		
Food production	Ø	Œ
Water provisioning	ŒŒ	Œ
Cultural services		
Education	Ł	Ø
Aesthetics	Œ	Ø
Recreation	Ø	Ł
Supportive services		
Nutrient cycling	Œ	Ø
Primary production	ØØ	Œ
Provisioning of habitat	Œ	Ø
Regulating services		
Water quality	ŒŒ	Ł
Flow regulation	ŒŒ	Ł
Erosion control	Œ	Ł

Appendix 5: Illustration of the two scenarios, *[top]* Global Orchestration (GO) and Adaptive Mosaic (AM) *[bottom]*



Appendix 6: Main Characteristics of the ski areas in the Allos valley (Office de Tourisme du Val d'Allos 2009)

	La Foux	**Le Seignus**
Altitude range	1500-2400 m	1800 -2675 m
Number of ski lifts	51	11
Number of Ski runs	80	25
Length of ski runs	180 km	no data
Opening time	December 12th - April 18th (127 days)	December 12th - April 5th (114 days)