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Journal of Alpine Research | Revue de géographie alpine

109-2 | 2021
La montagne et les nouvelles manières de faire connaissance

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Electronic version
URL: https://journals.openedition.org/rga/9189
DOI: 10.4000/rga.9189
ISSN: 1760-7426

This article is a translation of:
Le tourisme scientifique dans les Alpes françaises : un laboratoire pour la médiation scientifique et la recherche - URL : https://journals.openedition.org/rga/9337 [fr]

Publisher:
Association pour la diffusion de la recherche alpine, UGA Éditions/Université Grenoble Alpes

Electronic reference
Yannick Vialette, Pascal Mao and Fabien Bourlon, "Scientific Tourism in the French Alps: A Laboratory for Scientific Mediation and Research", *Journal of Alpine Research | Revue de géographie alpine* [Online], 109-2 | 2021, Online since 31 December 2021, connection on 08 December 2022. URL: http://journals.openedition.org/rga/9189 ; DOI: https://doi.org/10.4000/rga.9189

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AUTHOR'S NOTE

This contribution was supported by Labex-Item, the Parc National des Écrins, the AJIR project of the Ardèche department, the PASTSER CIEP ANID R20F0002 project and was made possible by the hosting of CREA Mont-Blanc and the Jardin du Lautaret (UGA).

Introduction

1 Scientific tourism in mountain areas perpetuates a traditional tie between scientific knowledge produced in that environment. The rise of mountaineering in 1786, date of the first ascent of Mont Blanc, illustrates perfectly the analysis of Morse (1997) showing existing links between explorations and scientific research. From the second ascent in 1787, Saussure carried out various observations and experiments. In his *book Les voyages dans les Alpes*, Saussure (1779-1796) offers a synthesis of his work resulting from his multiple peregrinations and mineralogy, geology, chemistry, physics, climatology, botany, zoology and geography descriptions (Barry, 1978; Archinard, 1988; Merland, 1988). They nourished a process of appropriation of these remote areas and associated mountain imaginaries (Mao, 2003; Gravari-Barbas, Graburn, 2012) allowing the invention and renewal of the alpine ideal (Joutard, 1986). In scientific tourism practices, scientific mediations allow the production and knowledge sharing. The hypothesis is that they fully participate in a continuous shaping of the concept of mountains (Debarbieux, Fourny, 2004). This space can also be seen as a laboratory for

scientific research (Debarbieux, 2001) and place for bridging ties between acquired knowledge and society.

2 This approach raises the question of how mediation within scientific tourism contributes to "getting involved" with the mountain environment. A rising interest of visitors for these new forms of tourism and ways of mediating knowledge will be debated. What added value does mediation bring to the tourist's experience? The central problem that structures this work can be summarized as follows: what does the study of the mediation process within scientific tourism teach us about this form of travel, its audiences and the places where they occur?

3 To answer this research question, the two notions of tourism and scientific mediation are redefined. Three case studies in a mountain environment are used. They were chosen due to their diversity with regards to scientific tourism and the types of scientific mediation implemented: the Jardin Alpin du Lautaret of the University of Grenoble Alpes, an itinerary carried out within the framework of the research project *Refuges Sentinelles* (Labex ITEM and Écrins National Park) and travel abroad experiences organized by the Centre de Recherche sur les Écosystèmes d'Altitude (CREA Mont-Blanc) of Chamonix. This research is quantitative (questionnaires) and qualitative (semi-directive interviews along with participant observations). Surveys were conducted during the 2019 summer, with visitors and actors involved in these initiatives.

The origins of the notion of scientific tourism

4 As Mao and Bourlon (2011, 1016) show, the notion of scientific tourism has been frequently used to qualify different forms of travels since the end of the 19th century. Laarman and Perdue (1989 a; 1989b) were the first to focus on scientific tourism as a research issue. They analyze the fieldwork carried out by American scientists in the protected natural areas of Costa Rica and the link with tourism dynamics. From their observation of practices, consuming patterns and travels induced during scientific missions, including those accompanying them and students, they use the notion of scientific tourism to describe these academic activities. Later the concept is used to describe other types of travel. Ilyania and Mieczowski (1992) observe how pedagogical tools are based on scientific knowledge during student trips to remote geographical borderlands of Russia. West (2008) sees it as an ecotourism practice, such as developed in Papua New Guinea within conservation and research projects funded by international organizations. Wearing and Neil (2000) describe it as eco-volunteering in environmental projects while Laing (2010) sees it as a tourism niche focused on biodiversity preservation and a source of income for research projects.

5 Molokáčová, Molokáč (2011) and Mao, Bourlon (2011) make similar observation of a great diversification of the use of the notion of scientific tourism, a source of existing confusion. In an attempt to overcome it, Mao and Bourlon (2011, 2016) conduct a literature review and offer a more general definition. They deduce two main variables that characterize these practices: the place given to science and the involvement of the tourist in the scientific research. They identify four main forms.

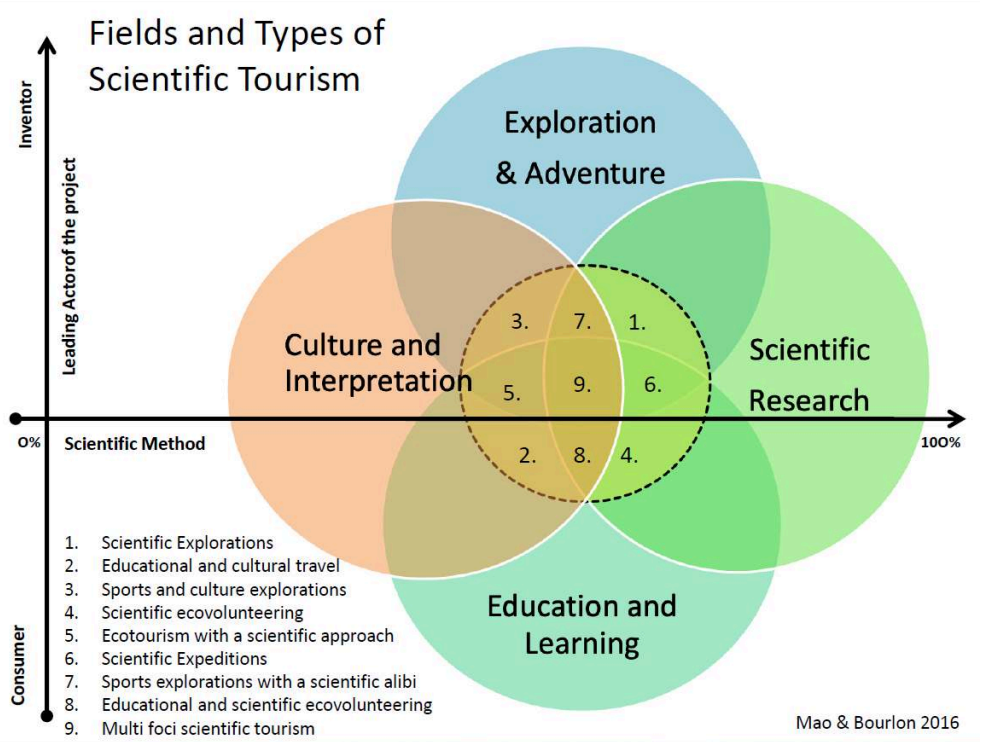
- Adventure tourism with a scientific dimension, this activity bridges scientific research and an adventure exploration, a longtime tendency history shows. This activity involves mainly researchers and explorers of most generally remote or lesser studied areas. National

Geographic organization is a good example of how exploration travels related to various scientific topics can be carried out. Science can be either an alibi (to justify the trip) or the main purpose of these adventures.

- Cultural tourism with a scientific dimension corresponds to cultural and heritage tourism where mediation, animation and/or scientific interpretation is carried out to inform visitors. Some travel agencies specialize in this activity. They offer science based visits such as those aimed at discovering ecosystems under the guidance of an environmental scientist or visits to volcanic areas accompanied by a geologist.
- Scientific eco-volunteering advocates for a more active participation of tourists in a conservation or research project. This type of initiative is promoted by NGOs, such as Objectif Sciences Internationale or Earthwatch. More generally it seeks to involve people already aware of environmental issues or who wish to be involved in scientific processes.
- Scientific research tourism relates to travel mobility of researchers when they carry out field observations. It is part of a professional activity and includes participation in conferences, seminars or meetings.

6 Mao and Bourlon (2011, 2016) also point out that in many cases, these four forms can be complementary in a particular location or project. West (2008) shows how an international research project can engage numerous field missions of scientists, internships of volunteers, and generate ecotourism attractions locally. Moreover, these four forms can be mixed with one another, giving way to a wide variety of alternatives in which scientific research can be associated with education, learning, culture, interpretation, exploration and adventure.

Figure 1: The four fields and nine forms of scientific tourism



Source: Mao, Bourlon, 2016.

7 Mao and Bourlon (2016) give examples of the diversity of scientific mediations that are at stake in each of the four main forms of scientific tourism. Mixing forms requires an adaptation and the diversification of scientific mediations.

The foundations of scientific mediation

8 Like scientific tourism, scientific mediation relates to ancient praxis, but its formulation as a research issue is rather recent and has given place to many debates (Bergeron, 2016). It has developed along with the notion of cultural mediation. It is based on the same idea but adapted to the transmission of scientific knowledge. The term meditation comes from the Latin: *mediatio* which means mediation, to settle a dispute or establish an agreement. It comes from the word medium which can mean in between, a means or a link. Mediation thus emerges as an act that favors the creation of a new relationship. Applied to culture, mediation is a connection between a people and a cultural object. In the scientific field (Las Vergnas, 2016), it is the interface between an audience and scientific knowledge.

9 Mediation attempts to go beyond the simple transfer of knowledge and adapt to the expectations and concerns of the audience (Caillet, 1996; Villebrun, 2016). Mediation gives way to the act of crossing boundaries between laymen and holders of knowledge, between popular knowhow and academic knowledge (Las Vergnas, 2016). This is a specific challenge of science and the sharing or dissemination of results (Bergeron, 2016). Mediation was initially thought of in a very top-down manner, with the knower transmitting to the layman. The French semantic choice to qualify these practices was to use the term “vulgarization” (from the latin *vulgus*, the little people) rather than “popularizing” (from the latin *populus*, the people who vote). This choice was very significant in the desire to embrace all audiences (Jeanneret, 1994). However, it has continued to suffer from this tie to the word “vulgar” and its negative connotation. This understatement has favored the emergence of new expressions since the beginning of the twentieth century: “journals of high popularization” in the 1930s, “scientific propaganda” following World War II, “scientific information”, “scientific culture” and more recently “scientific mediation” (Bergeron, 2016). It should be noted that the change in terminology does not always seem to be accompanied by changes in practices (Bergeron, 2016). In the 1970s, Jurdant (1973) shows the weaknesses of scientific popularization and the need to rethink processes. Jurdant (2009) states that instead of making scientific discourse accessible, transmitting knowledge, and educating audiences, popularization formats people's thoughts. It dictates questions they should ask themselves and thus makes them dependent on the knowledge of the knower. Bensaude-Vincent (2010) makes the same remark about a growing gap between science and society. The author underlines that popularization is too often seen as a report on the state of such and such work but does not seek to integrate “laymen” into these debates.

10 This is why the implementation of scientific mediation needs to overcome these criticisms and favor changes of methods. Indeed, it involves the act of transmitting knowledge but seeks to renew the manner. Moreover, the mediations must always be scrutinized and be reflexive (Faury, 2017) in order to legitimize and explain to the audience why this scientific communication is not neutral in how knowledge is given (Masseran, Chavot, 2013). Tourism, with its ability to put individuals in informal

learning situations (Brougère, 2012 a and b), can facilitate processes and experimentations. Kramar (2011) shows that scientific mediations are already very present when enhancing natural heritage and touristic locations. These mediations appear to be the foundations of experiential tourism. Mao and Bourlon (2016) synthesize this observation by identifying related types of mediation for each form of scientific tourism:

Table 1: Brief description of the scientific dimension and the mediations involved in each four forms of scientific tourism.

	Adventure tourism with a scientific purpose or alibi.	**Cultural tourism with scientific contents**	**Scientific eco-volunteering**	**Scientific research tourism**
Dimension and purpose of the scientific contents	Used to justify the exploration or sports challenge	Cultural mediation to explain ecosystems and environmental issues	Active and participatory mediation in natural or cultural environments.	Within scientific experiments and field research under specific protocols and methods
Mediation process of scientific knowledge	Knowledge dissemination to a wide audience	By sharing scientific knowledge and know-how	By experiencing and through training	By academic and scientific recognition (congress or papers)

Source: the authors, 2021, modified from Mao, Bourlon, 2016.

11 Due to the increase of alternative tourism and use of mediation techniques that take into account symbolic dimensions, Kramar (2011) sees a field of opportunities for scientific tourism. This implies a diversity of mediations to be reviewed and reinvented. Moreover, the mountain, as an open-air laboratory (Debarbieux, 2001), represents an ideal field of action and opportunities (Bourdeau, 2006), for the development of scientific mediation. The following examples informed here after bear witness to this.

The mountain: a field of experimentation for tourism and scientific mediation

12 To date, work on scientific tourism has been largely developed in borderlands and remote geographic areas. This is the case with those of Laarman and Perdue (1989 a and b) in Costa Rica, West (2008) in Papua New Guinea or Mao and Bourlon (2016) in Chilean Patagonia. The contribution of this research is to question the role of scientific tourism in a much more touristic location, the French Alps. Various initiatives have been developed there in recent years. Three of them have been selected for this study, the Jardin Alpin du Lautaret, the CREA Mont-Blanc and the partnership between the Écrins National Park, a mountain guide and a research program.

13 These complementarity cases permit a cross approach, with both qualitative and quantitative data. The quantitative approach was carried out at the Jardin Alpin du Lautaret of Grenoble Alpes University. This alpine garden has been a high place for tourism and science for over a century. It is a branch of the Alpine Ecology Laboratory (LECA-UMR, CNRS-UGA), a place for hosting researchers and students and finally a botanical garden open to the public as it gathers representative species of many mountain areas worldwide. During the 2019 summer season, a questionnaire was applied to 577 participants during guided tours. It addressed issues to knowledge such as history, botany and the scientific research conducted on the site.

14 The qualitative approach is based on 22 semi-structured interviews and participant observations (Kaufmann, 2011) carried out during two visits. On the one hand, they involved eight American students of a master's degree of the University of Boulder, Colorado. They were hosted for a week, in May 2019, in Chamonix by the CREA Mont-Blanc organization. This private research center specializes in the study of high altitude ecosystems and develops many forms of scientific mediation, ranging from a series of conferences, the implementation of participatory science projects and eco-volunteerism such as the organization of students and scientists' stay. These interviews took place in a refuge during a three-day immersion. This also allowed for many informal moments that favored the deepening of answers during the interviews, by comparing the activities proposed and resulting experiences. A second series of interviews was conducted 6 months after the stay to identify the most significant moments and recalled experiences.

15 On the other hand, interviews (during the stay and after, 6 months later) were conducted with the first participants and stakeholders of a trekking activity offered by an alpine mountain guide in August 2019. Under the Écrins National Park label ("Esprit Parc"), it is organized within the framework of the research project *Refuges Sentinelles* (Reflab) financed by the Labex ITEM program. This hike offers an itinerary that includes different mountain huts, partners of the project, and that aims at transmitting recently acquired scientific knowledge on environmental changes observed in the high mountains. Guiding the group along this itinerary favored many exchanges relating the present issue of this work (scientific tourism project, cultural and scientific mediations and expected outcomes from sciences).

16 These examples reveal that a diversity of project leaders exists, structure and develop the scientific tourism offer. This can be the private sector, CREA Mont-Blanc, guides and refuges, as well as public stakeholders, with the University and the Jardin du Lautaret. The trekking itinerary in the *Refuges Sentinelles* shows the possibility of mixed partnerships. It is offered by a mountain professional based on a program co-directed by public structures (here, the Écrins National Park and the Labex-Item research program). Participant observations and the diversity of projects studied show innovating mediations being implemented, all aim to go beyond the simple transfer of knowledge (Caillet, 1996; Villebrun, 2016). They show how science and society are trying to bridge (Caunes, 2008; Haigneré *et al.,* 2010) and a frontier separating knowledge and expertise (Las Vergnas, 2016). Moreover, this dynamic is part of a renewed interest in participatory science illustrated by the report recently commissioned by the Ministry of National Education, Higher Education and Research (Houillier, Merilhou-Goudard, 2016).

Mediations specific to each form of scientific tourism

17 These initiatives are representative of a diversity of scientific projects and mediations. The Jardin du Lautaret promotes cultural tourism with scientific content. By a museographic approach, it favors the dissemination of knowledge about high altitude ecosystems. Through interpretation (Tilden, 1957) a range of scientific knowledge is transmitted to a wide audience. This can be achieved by elaborating interpretive materials and supports distributed throughout the visited area or during guided tours that focus on sharing information. These mediation tools appear relatively classical and top-down approach, sharing with visitors a variety of knowledge. However, the approach of the botanical garden of Lautaret is unique. The garden's discourse is exclusively centered on botany to foster the visitor to ponder on a large corpus of research and scientific themes (human - environment interface and ecology in the broad sense). In addition, the new tools and guided tours encourage discussions on the scientific issues addressed by the alpine ecology laboratory of the University of Grenoble (LECA-UGA) located on the site. Different issues are presented to a wide audience in order to motivate visitors to question contemporary and global environmental issues. Climate change is a major issue here. The role played is that of stakeholders to raise awareness by comparing observations made on the site, such as the evolution of the altitudinal staging of the floral stations, the glacial retreat, the changes on the fauna population with the acquired scientific knowledge.

Illustration 1: A visit to the Jardin du Lautaret and its scientific facilities

Source: Parc National des Écrins, 2019.

18 The CREA Mont-Blanc, the second case study, relies on a more proactive mediation with the students and tourists involved. Within the framework of eco-volunteerism and participatory research (Houllier, Merilhou-Goudard, 2016), the visitor is invited to take

part in the research protocols. The following examples express this dynamic. The Atlas Mont-Blanc project collects data and information to map the biodiversity in the mountain range. The Phénoclim project is a citizen science initiative that involves local community and visitors to observe the natural mountain environment. Both seek to collect a large number of observations that favor a better understanding of the evolution of the mountain ecosystems in a diachronic way in direct relation to climate change. The scientific mediation is thought here as consubstantial with the experiment and the field experimentation. Although these approaches are aimed more specifically at a local audience, participatory science protocols are called upon during tourism tours. In addition, the CREA Mont-Blanc offers more traditional mediation activities, such as discoveries of the mountain accompanied by scientists presenting their research or conferences for a general audience. The travel abroad activity studied is organized by the CREA Mont-Blanc. The course is part of a university career and is given credit within the student's curriculum. This trip ties two issues related to public policy and environmental law. The stay aims at giving students a comparative insight of French and North American approaches to environmental management. The laboratory stages the course with numerous forms of mediations: meetings with scientists presenting a work-in-progress, treks accompanied by scientists, situational exercises and participatory science.

19 The *Refuges Sentinelles* program is a sport and cultural tourism trip with a scientific dimension. During the hut to hut hike, each day is assigned a specific scientific issue: geography, climatology, geomorphology or evolution of mountain recreational activities. The guide organizes activities that rely on different scientific mediation supports. His training as an alpine mountain guide along with his interest in specific scientific issues, his experience and his professional activities with universities allow him to offer a wide range of landscape analysis with diverse educational tools. He uses interpretation tools and maps made available by the Reflab program to legitimize the scientific content. Each day of the tour is marked by meetings with hut guardians and researchers involved in the Reflab program and the Labex ITEM program. The visitor interacts with the guides and stakeholders in a personalized manner. The groups are voluntarily small and mediation strategies express the will to implement experiential processes (Masseran, Chavot, 2013; Faury, 2017).

Tourists and scientific mediation at the Jardin du Lautaret

20 The Jardin du Lautaret, with its 20,000 summer visitors, ranks among the ten most visited paying tourist sites in the Hautes-Alpes area. To give an idea of the scale of visitation, the Écrins Park visitor's center receives from 10,000 (in Orcières) to 65,000 annual visitors (in Briançon). The Departmental Museum of Gap (archaeology, fine arts, history and ethnography) and the House of water and energy of Serre-Ponçon have an annual of 15,000 visitors. Numbers show that the botanical garden, focused on high-altitude ecosystems and botany, is very attractive. The scientific activities (Cailloce, 2019) of the university campus of the Lautaret, next to the botanical garden, gave way to some 58 research projects in 2019. In addition to several thousand days of fieldwork data gathering, researchers and students support inputs and monitoring useful for scientific mediation and defining issues to be shared with tourists. Although only 17.5%

of the visitors claimed to come specifically for the scientific importance of the garden, more than 68.7% are attracted by gaining knowledge related to botany. Nearly 80% of those surveyed said they were “quite” or “fully” interested in scientific issues.

21 These results echo those of Kramar (2011) showing that science can contribute to the give new value to natural areas and, at the same time, to enhance new experiences by stimulating the curiosity of the visitors. Study shows that 80% of the garden's visitors consider that the scientific mediation has met their expectations (53% say they are rather satisfied, 27.5% completely satisfied). Their evaluations are very positive regarding the scientific mediation (with an average evaluation of 7.79 out of a maximum of 10) and the botanical knowledge (8.75 out of 10). A 99.8% of them would recommend the visit to a third party. Moreover, 76% of the respondents declare that the visit stimulated their curiosity thanks to the way scientific issues were brought up, especially among the young public. The mediation also contributes to giving more meaning to visit. Spontaneously, the respondents describe the visit, in decreasing order of citations, as “interesting” (95 occurrences), “magnificent and pleasant” (85 occurrences), “beautiful and enriching” (83 occurrences) and “instructive” (80 occurrences). More than 90% of the garden's visitors feel that they had a better understanding of the surrounding landscapes after the visit and that the scientific information they received played a central role in that.

22 The garden's public remains sociologically and culturally marked. The surveyed group showed a high level of education (82% had done 2 years of university education when the average for the French population is of only 30%). The higher socio-professional categories were much represented (29% were executives and intellectual professions, numbers to be compared with the average of 19.3% in France) and involved older persons (two thirds of the visitors were more than 50 years old and 36% retired persons). This supports Origet du Cluzeau's (2005) observations on cultural tourism in France, of which scientific tourism is a part; some 80 to 85 % of the visits to cultural sites are done by 15 to 20 % of the national population. Between 45% and 60% of visitors are occasional visitors, especially within the tourism season. Chadefaud (1987) also showed that mountain tourism is mainly of interest to the upper social classes.

Scientific mediation, at the crossroad between learning and new tourism experience

23 Semi-directive interviews conducted during other scientific tourism trips organized by CREA Mont-Blanc and the itinerancy in *Refuges Sentinelles*, allows for a more qualitative interpretation of the mediation processes. Interest for science in tourism and leisure activities is highlighted by the multiple activities and experiments implemented by CREA Mont-Blanc. The American students had high expectations of the various scientific activities: “I want to learn more about science, because I find that the more we learn about science the more I feel that we are effective decision makers.” The particular context of a university travel abroad experience is that science is seen as transversal and complementary to other activities of the stay (such as visits and interviews with stakeholders). It allows for the development of a global approach to the Chamonix territory. Complementary observations to recorded discourses reveal a high level of commitment and interest, as shown by the quality of their talks, research questions or ability to formulate hypothesis. They emphasize on the contribution of

science to answer their interrogations about the impacts of climate change on mountain ecosystems: “Yes, I am totally interested because I am also really interested in ecology, the protection of biodiversity ecology and wildlife in general.”

Figure 2: Students in the middle of scientific observations

Source: H. Gerardi - CREA Mont-Blanc, 2019.

24 The profile of the participants in the itinerancy in *Refuges Sentinelles* is different. While their interest in science is high, they do not have a high training in life and earth sciences. They chose this program because of the added value of science. “It's a desire to give more meaning to the vacations, not only to relax but also to really learn things.” Another hiker adds, “when we saw this offer, what interested us was to better understand the mountain, such as geology, geomorphology and all the other aspects that were explained to us, because otherwise, like everyone else, we go to the mountains, see peaks, glaciers, snow and... ah it's beautiful, but we don’t really understand anything.” Science is seen here as a way of enriching and providing answers to their questions. These expectations are quite similar to those of American students. In summary, science comes to answer a quest for knowledge because “You don't need a scientific education to be interested in things, but you need curiosity and that's what we have”. Mediations are then seen as a way to access to knowledge and thus give meaning to one's tourism experience while appreciating a unique moment.

Illustration 3: An Immersion in the Écrins, the terrain of the Sentinel Shelters program

Credit: O. Bello, 2019.

25 This desire to gain new knowledge is regularly expressed throughout the visits. The day the CREA Mont-Blanc organization dedicates to participatory sciences is what Kramar (2011) refers to as an experiential process. The strong personal involvement observed within the group and the unanimously positive feedback, show that they had a very special day. The existing relationship between knowledge and experience is also supported by a hiker from the hut to hut program of *Refuges Sentinelles*. "It's like if you go to visit a castle, if you don't have a guide to understand the construction techniques, if you don't have a guide to help you understand your environment, well it's exactly the same thing that motivates this idea of a scientific hike, it's the idea of understanding something, not just saying that it's beautiful." The new meaning that the scientific approach gives to the surrounding landscape seems to allow a stronger awareness of global issues. A hiker suggests that "there might be a greater attachment to the mountain, not only the Écrins. Because we better understand the mountain now, even if we are elsewhere, as we see things, we will feel more concerned, without wanting to compare myself with mountain people, that would be an exaggeration, but we will be more sensitive because we understand things".

Conclusion

26 The group of initiatives studied reveals a plurality of scientific tourism forms and the uniqueness, or specificities, of scientific mediations that were used. The demand for such scientific approaches exists and is diverse. The quantitative approach highlights specific expectations of persons seeking a particular knowledge on one thematic but willingly allowing themselves to be surprised by other scientific issues. The qualitative

approach highlights immersive (experiential) forms of tourism, seeking meaning and knowledge. A plurality of mediation processes appears as necessary as it responds to a variety of expectations. The surveys and interviews show a high level of satisfaction of beneficiaries of these mediations. They enhance curiosity and the desire to learn new knowledge. Involvement of visitors and the preoccupation shown to answer their questions (Caillet, 1996; Villebrun, 2016) were clearly felt within each initiative.

27 The study of mediation processes further demonstrates the strong link between experiencing and knowledge acquisition (Kramar, 2011). Positive answers registered within the interviews describe the quality of the experience during the visit to the botanical garden (results remain descriptive for the moment). This relationship is also identified within the more immersive experiences, whether they are imposed (university setting) or chosen (free time). The interviews allow us to better understand this link. Not only do mediations meet tourist expectations, but they also allow a better understanding of the visited territory and provide answers to questions about global issues, which are difficult to grasp otherwise.

28 Mediations are therefore opportunities to rethink the ties between science and society (Caunes, 2008; Haigneré *et al.,* 2010). The analysis highlights the relevancy of the four spheres of scientific tourism summarized by Mao and Bourlon (2011, 2016) and suggests that their nine-form approach (Figure 1) relates adequately to the specific initiatives studied. Scientific tourism can be thought of as the whole range of tourist or leisure travel experiences that involve scientific mediation.

29 The mountain environment is an ideal laboratory for these initiatives. Due to the diversity of scientific practices and objects that can be involved, multiple forms of scientific tourism can be thought of and reinvented. Scientific mediation itself should be reinvented in a permanent process of innovation and creativity. They also offer the opportunity to create a new tourism attraction and to contribute to raising public awareness on various contemporary issues.

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ABSTRACTS

This contribution focuses on scientific mediation implemented within scientific tourism initiatives in mountain areas. Three case studies in the French Alps support this research: the Jardin Alpin du Lautaret of the University of Grenoble Alpes, the CREA Mont-Blanc, a private research center organizing participatory science and student travel abroad programs and the scientific hut to hut trekking routes in the Écrins National Park, organized jointly with a scientific research project (Labex ITEM, Reflab). Scientific tourism and mediation are first defined. Next, a quantitative and qualitative approach (with interviews and participant

observations) allows us to understand the impact and role of scientific mediation within tourism. Results show a high level of interest of the issue within involved publics and a close connection between experience and knowledge. It appears that it is also a tool for public awareness of the challenges of our modern societies.

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Keywords: tourism, science, mediation, mountains, scientific tourism

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