INHABITED AREAS SECURISATION AGAINST ROCKFALLS IN THE FRENCH RIVIERA

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INTRODUCTION

In France, in the Alpes Maritimes, between Nice and Monaco, the Alp Mountains dive onto the sea. A lot of inhabited areas are subject to rockfall hazards, as the Monaco Princedom. Public utilities and Monaco Princedom have launched a safety operation since 2004. The operation cost amounts to 20 M€ in five building phases. All the sites are classed into Natura2000 area of the "Corniches de la Riviera" and about twenty protected wildlife species are numbered.

Fig. 1 Tête de Chien cliffs above Cap d'Ail and Monaco and wild species

Two of them are endemic of the sites. After impact studies and requirements stated by the DREAL, the first safety building phase is finished. This building phase has pointed out the necessary adaptations that the building companies had to perform, in order to apply the government department specifications (MEDDTL). This first building phase has been successful as well in the application of the wildlife species protection than in the landscape insertion. New proceedings of buildings and protections have been applied by the building company.

DEPARTMENT OF THE ENVIRONMENT REQUIREMENTS

Several requirements are imposed to the project owner:
Suppression measures consist of adapting the technical solutions and their implantations before the building.
Reduction measures consist of writing in the work company contract, the obligation to respect the protected species of fauna and flora. The companies have to present in their tender the means allowing, in their proceeding, the protection of the species. The project owner has to prepare, manage and control with an expert company, the impact and adaptations during the building phases. This company has to ensure the education of all the workers on the sites.
Compensation measures are project owner responsibilities. These measures consist of the implications of project owner in the protected species research programs, regular meeting organisation with DREAL, the result evaluation of the impact of the protecting works and the zoning biotope map forbidding inhabited area development. Furthermore, the project owner has to give up a large area reserved to the protected species.

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RESULTS

Before the beginning, all the species stations were located and protected before clearing of brushwood. The implantations of the constructions were adapted and controlled.
All the workers were educated to recognise protected species. A vade mecum was distributed to the workers and present on the work sites
The building company was responsible of his intern control concerning the protected species and was controlled by the external control of the project owner.
A work mark-up has been installed during all of the work. This mark-up had to regulate all the displacements of the workers on the site.

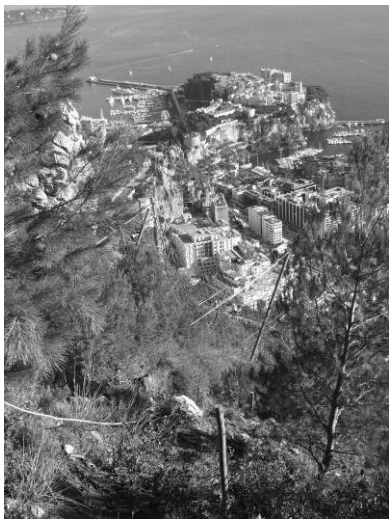

Fig. 2 Example of mark-up above Monaco

Fig. 3 Protections installation

The protections constructions were adapted not to be too visible in the landscape. In this case, the reduction of the brushwood clearing and the painting of the elements have given a good result. This operation has been performed with the same remaining rockfall hazards.
The first building phase allows to prove the possibility of:

- Reducing rockfall hazards with efficient protecting constructions,
- Imposing to the buildings companies to respect very restricting proceedings
- Performing efficient reduction measures on protected species
- Measuring the real impact on the protected species caused by the building phase
- Improving the landscape insertion in a very tourist region

This operation is one of the first examples in France in which such adaptations are followed in a safety building construction in mountains areas.

REFERENCES

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