Ecological insights and conservation recommendations from an intensive survey of French orchids

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The Atlas of French Orchids directed by the French Orchid Society (SFO) involved about 3000 specialists, belonging to regional working groups thanks to a participative approach. Objectives were firstly to precise species distribution and ecology, to identify threatened species according to IUCN criteria and to provide recommendations for their conservation. Overall, more than 110,000 stations were referenced and 160 taxa were reported in 26 genera (Dusak and Prat, 2010, Biotope-MNHN, 400 p.).

At low elevation, most taxa are observed in dry conditions, essentially on limestones (Fig. 1). Species range can be large at the national level (Fig. 2) or restricted, particularly in endemic species (Fig. 3).

Species distributions were used to assess the extent of occurrence and area of occupation, which in combination with demographic trends recorded in the stands allowed to determine the IUCN species status according to regional guidelines version 3.1 (Table 1).

This revealed that one species (*Anacamptis collina*) is Regionally Extinct, four species (*Hammarbya paludosa*, *Ophrys aveyronensis* (Fig. 3), *O. eleonorae* and *O. philippi*) are Endangered and 23 species are Vulnerable (in genera: *Anacamptis*, *Chamorchis*, *Cypripedium*, *Dactylorhiza*, *Gymnadenia*, *Herminium*, *Liparis*, *Neotinea*, *Ophrys*, *Orchis*, *Platanthera*, *Serapias*). These species are mostly threatened by wetland loss and agricultural practice changes (Fig. 4). Some of these threatened species are not yet protected at the national nor local level. Further investigations are required for taxa classified as Data Defficient.

Investigated areas present a large ecological variation concerning climate, elevation, geology and anthropic influences. Thus, using a maximum entropy approach (Maxent: Philips *et al.*, 2006, Ecol. Model., 190:231-259), we investigated the main bioclimatic drivers of the orchid distributions, considering components of the climate, such as the extreme values in temperature, precipitation, and the seasonality. We also predicted changes in potential orchid distributions according to scenarios of climatic change (Fig. 5). This helps to assess future threats and conservation priorities.

Official protection of additional species is recommended as well as the ecosystem conservation particularly for wetlands in order to keep species in their environment.

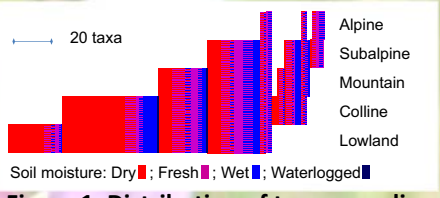


Figure 1. Distribution of taxa according to elevation and soil moisture.

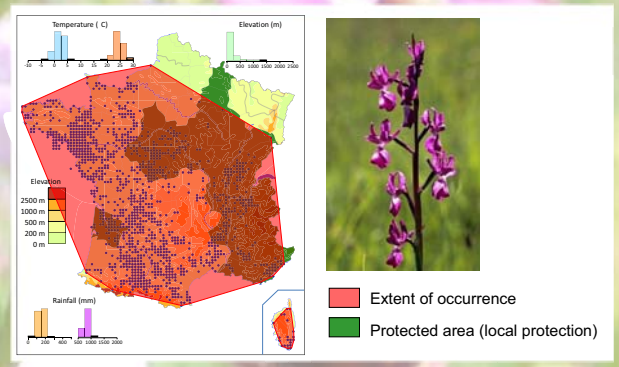


Figure 2. Distribution of *Anacamptis laxiflora* on continental and island national territory; species classified as Vulnerable because of general population decrease in spite of a large range; local protection is implemented only in marginal populations.

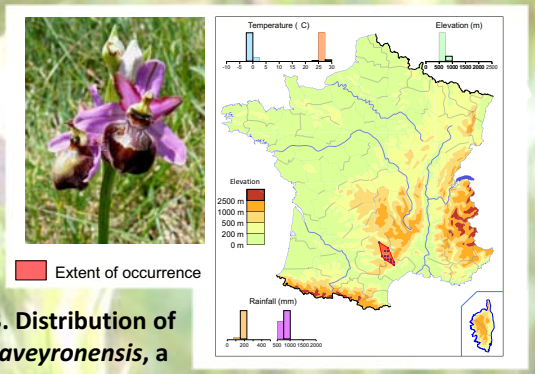


Figure 3. Distribution of *Ophrys aveyronensis*, a French very restricted species classified as Endangered because of small population and population decline; the species is still threatened in spite of a national protection.

Table 1. IUCN Status and official protection of French orchid species.

IUCN status	National protection	Local protection	Without official protection
Regionally Extinct RE	1	-	-
Critically Endangered CR	-	-	-
Endangered EN	2	-	2
Vulnerable VU	9	11	3
Near Threatened NT	8	16	11
Least Concern LC	1	46	16
Data Deficient DD	-	6	27

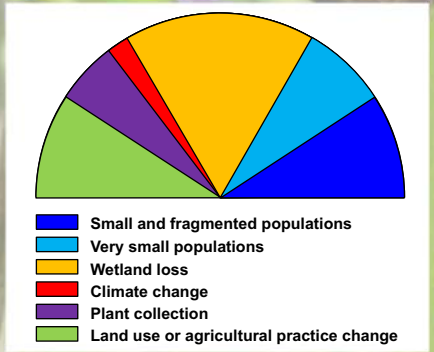
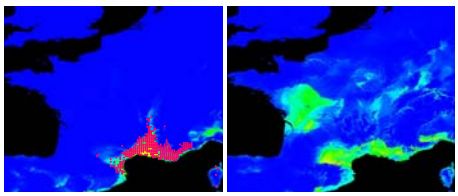
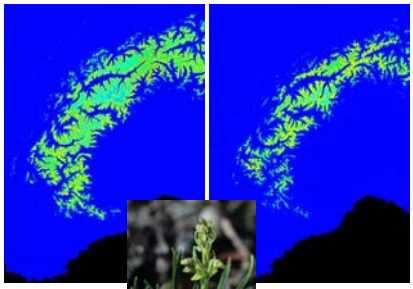


Figure 4. Main threats identified in French orchid species classified as Endangered or Vulnearable.



Potential expansion of *Himantoglossum robertianum* range (on the right, present range on the left) under doublement of atmospheric CO_2 content.



Expected regression of *Chamorchis albida* range in Alps (on the right, present potential range on the left) under doublement of atmospheric CO_2 content.

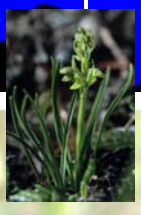


Figure 5. Contrasted expected range variation in two orchid species after temperature increase related to atmospheric CO_2 content.