

RECOVERY SUCCESS OF THE NATIONALLY THREATENED AND PROTECTED  
WETLAND PLANT SPECIES *CALLA PALUSTRIS* L. IN THE VOSGES MOUNTAINS  
(FRANCE)Serge MULLER<sup>1</sup>

RÉSUMÉ. — *Succès du rétablissement dans les Vosges (France) de Calla palustris L., espèce menacée et protégée au plan national.* — *Calla palustris*, une plante protégée et menacée en France, avait subi au cours du 19<sup>ème</sup> et de la première moitié du 20<sup>ème</sup> siècle une forte régression consécutive à la destruction de son habitat dans le massif Vosgien, où cette espèce trouve ses seules localités françaises. Ainsi, sur les 18 stations découvertes dans ce territoire au 19<sup>ème</sup> siècle, seules 4 subsistaient dans les années 1950. Cette espèce a présenté au cours de la deuxième moitié du 20<sup>ème</sup> siècle une restauration de ses populations et de son aire de distribution, résultant dans les Vosges du Nord d'une colonisation naturelle consécutive à la protection de son habitat et, dans les Vosges du Sud, principalement d'opérations réussies d'implantation de l'espèce. Cette restauration (16 stations observées en 2007) a été permise par les fortes potentialités de reproduction végétative de l'espèce, par la déprise agricole et la protection des zones humides. *Calla palustris* peut ainsi être considérée comme une « espèce bleue », c'est-à-dire une espèce menacée qui a rétabli ses populations.

SUMMARY. — *Calla palustris*, which is considered as a threatened plant species and is under protection in France, suffered during the 19<sup>th</sup> and first half of the 20<sup>th</sup> centuries a strong decrease following wetland destruction in the Vosges Mountains, where this species possesses its only natural French locations. As a result, among the 18 locations discovered in this area, only 4 remained in the 1950s. This species showed a recovery of its populations and distribution area in the second half of the 20<sup>th</sup> century, resulting from natural colonization in the northern Vosges following habitat protection and mainly reintroduction in the southern part of the Vosges. This recovery (16 locations in 2007) was permitted by its high vegetative reproduction ability and by land abandonment and wetland protection. *Calla palustris* can therefore be considered as a "blue species" in this area, i. e. a threatened species which re-established its populations.

---

*Calla palustris* L. is a circumboreal plant species which is rather continental in Europe. It reaches its south-western limit in the north-eastern part of France (Meusel *et al.*, 1965). In France this plant is rare, only located in the Vosges Mountains, with the exception of one little location in the Warndt area in Lorraine near the German border, where it could not be found again in the last years. This plant species is therefore under national protection in France (Danton & Baffray, 1995). It figures as a priority species in the red data book of threatened plants in France (Olivier *et al.*, 1995). In Belgium it is also very rare and is considered as a threatened plant species (De Sloover *et al.*, 1979). In Germany, it also figures in the red data book and is considered as endangered (Korneck *et al.*, 1996). It is also a protected plant in this country (Sebald *et al.*, 1998).

---

<sup>1</sup> Laboratoire des Interactions Écotoxicologie, Biodiversité, Écosystèmes (LIEBE), UMR CNRS 7146, Université Paul - Verlaine, rue du Général Delestraint. F 57070 Metz. E-mail : [muller@univ-metz.fr](mailto:muller@univ-metz.fr).

At a phytosociological level, *Calla palustris* is considered by Oberdorfer (2001) as a characteristic species of the *Cicuto-Caricetum pseudocyperi*, a mesotrophic sedge-mire community. It also occurs in more oligotrophic *Carex rostrata* communities and *Alnion* forests.

*Calla palustris* is located in the Vosges Mountains in two areas, the northern Vosges on sandstone, where at least 9 locations were indicated in the 19<sup>th</sup> century by Schultz (1846) and Kirschleger (1857), and the south-western part of the Vosges on granite rocks around Gérardmer, where also 9 locations were discovered in the 19<sup>th</sup> century (Mougeot, 1836, 1845; Berher, 1876; Godron, 1883). In these two areas, it suffered a strong decrease, caused by wetland destruction, during the second half of the 19<sup>th</sup> and first half of the 20<sup>th</sup> centuries (Gérard, 1890; Lemasson, 1920). As a result, only 4 locations were listed by Engel & Kapp (1961) for the Vosges Mountains on the occasion of the visit of the French botanical society in Alsace in 1959, three in the northern part (Erbenthal, La Petite-Pierre, Eschbourg) and only one in the southern part, located at the lake of Retournemer. They constituted at this time the only natural locations in France of *Calla palustris*.

During the second part of the 20<sup>th</sup> century, new locations of *Calla* were discovered in the northern Vosges (Kapp, 1967; Muller, 1977; Engel *et al.*, 1979). In the southern Vosges, botanists have been attempting to create new populations since the 1960s by plant transfer (generally floating rhizomes) from the Retournemer site. The aim of this paper is therefore to analyse the current situation and ecology of *Calla palustris* in the Vosges Mountains and to discuss its recovery in this area.

## METHODS

All currently assessed locations of *Calla palustris* in the Vosges Mountains were visited in 2006 and 2007. In each site, information related to the history of the plant was gathered, area of cover of *Calla* estimated, habitat noticed and water analysis performed.

## RESULTS

### NORTHERN VOSGES

In the northern Vosges, 9 locations were found in 2006 and 2007 (Fig. 1, Tab. I). In the peatbog of Erbsenthal, *Calla* remains very common. The extension at the Hammerweiher, downstream of the La Petite-Pierre and Eschbourg ponds, was noticed since the 1960s (Kapp, 1967). Two new locations were discovered in ponds in the 1970s near the German border (Muller, 1977; Engel *et al.*, 1979) and one noticed several years later along the river Zinsel downstream of the Baerenthal pond (Muller, 1991). Three further small places were discovered during the last years, bringing to 10 the number of locations. But the disappearance of the historical La Petite-Pierre location following habitat destruction was also observed in 2006.

Water analysis in these sites (Tab. II) showed weakly mineralized water (conductivity generally around or lower than 100  $\mu\text{S}/\text{cm}$ ). Water can be very acid (pH lower than 5), but generally around 7. Nutrients (nitrates and phosphates) can be very low, but exceptionally exceed 1 mg of N-NO<sub>3</sub> and 200  $\mu\text{g}$  of P-PO<sub>4</sub>. Water alkalinity is also weak, generally lower than 1 meq/l. So *Calla palustris* occurs in the northern Vosges wetlands as well in very acid and oligotrophic waters as in neutral and mesotrophic waters. Habitats are also diverse, varying from *Carex rostrata* peatbog communities and *Berula erecta* river border communities to oligotrophic *Salix aurita* shrubs and mesotrophic *Alnus glutinosa* forests.

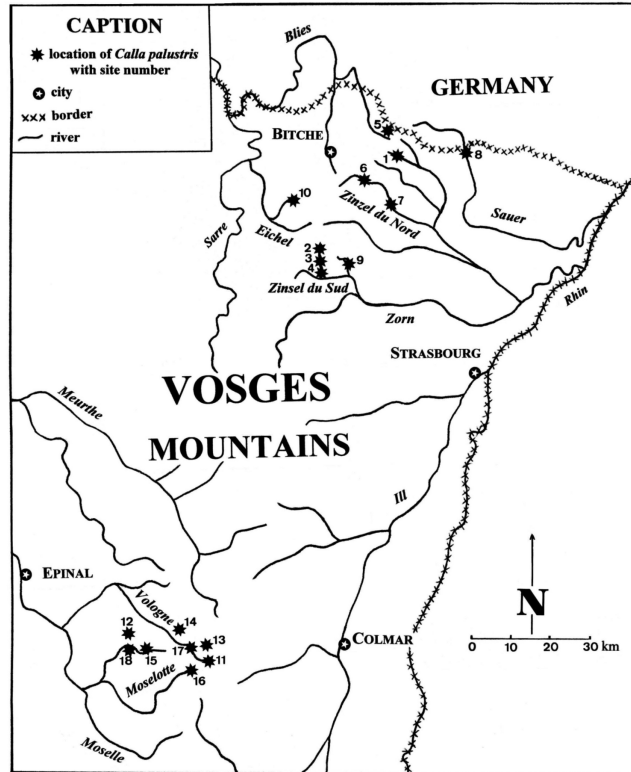


Figure 1. — Locations of *Calla palustris* in the Vosges Mountains.

TABLE I

Current and recent localities of *Calla palustris* in the northern Vosges, classified following the year of first data

Site n°	Location	Altitude	Commune	Author and year of 1 <sup>st</sup> data	Area size	Habitat
1	Peatbog of Erbsenthal	250 m	Eguelshardt	Schultz, 1846	5	<i>Alnus</i> forest and peatbog
2	La Petite-Pierre pond	220 m	La Petite-Pierre	Kirschleger, 1857	† in 2006	Mesotrophic <i>Alnus</i> forest
3	Eschbourg pond	210 m	Eschbourg	Himpel, 1886	4	Pond border
4	Hammerweiher	200 m	Neuwiller-lès-Saverne	Kapp, 1967	4	Pond border
5	Pfaffenbruch pond	290 m	Roppeviller	Muller, 1977	3	Oligotrophic <i>Salix</i> shrub
6	Baerenthal pond	210 m	Baerenthal	Muller, 1977	5	Mesotrophic <i>Alnus</i> forest
7	Zinsel river by Untermühlthal	200 m	Baerenthal	Muller, 1991	4	River border
8	Sauer river near German border	200 m	Lembach	Génot, ~1995 (pers. comm.)	1	River border
9	Maïbaechel	220 m	Neuwiller-lès-Saverne	Pujol, 2001 (pers. comm.)	3	Pond border
10	Ratzwiller in the valley	240 m	Ratzwiller	Morelle, 2006 (pers. comm.)	3	Mesotrophic <i>Alnus</i> forest

Area scale: † (plant disappeared), 1 (< 1m<sup>2</sup>), 2 (from 1 to 10 m<sup>2</sup>), 3 (from 10 to 100 m<sup>2</sup>), 4 (from 100 to 1000 m<sup>2</sup>), 5 (> 1000 m<sup>2</sup>).

TABLE II

*Results of water analysis (sampling on 24/08/2006)*

Site n°	Location	pH	Conductivity µS/cm	NO3 mg N/l	NH4 mg N/l	PO4 µg P/l	Cl mg/l	SO4 mg/l	Alkalinity meq/l	Ca mg/l
5	Pfaffenbruch	4.6	58	0.02	0.01	0	2.4	15.9	0.01	3.5
1	Ersenthal	5.9	47	0.01	0.01	2	2.4	4.9	0.24	5.2
9	Maïbaechel	6.8	102	0.25	0.05	7	4.8	22.7	0.25	9.4
6	Baerenthal	7.0	91	0.30	0.22	29	8.3	7.0	0.44	7.4
10	Ratzwiller	7.1	294	0.11	0.17	235	7.1	11.9	2.71	36.3
8	Sauer	7.3	109	0.43	0.22	51	9.0	9.3	0.53	9.3
7	Zinsel du Nord	7.3	85	0.38	0.07	22	7.8	6.7	0.38	7.1
3	Eschbourg	7.8	139	1.08	0.04	86	7.2	9.4	0.89	14.9

## SOUTHERN VOSGES

In the southern Vosges, 7 locations were found in 2006 and 2007 (Fig. 1, Tab. III). The first one (site n°11) is the historical location of Retournemer lake, where *Calla palustris* is being indicated since the beginning of the 19<sup>th</sup> century. Another site (n° 17) is located at the Longemer lake, about 4 km downstream of the previous lake, and it probably results from natural colonization. The 6 other locations (one of them currently disappeared) come from the introduction by nature protectors of fragments of rhizomes collected in the Retournemer site. These plants were introduced between 1965 and 1993 in artificial ponds created in peatbogs or quarries in the surroundings of Gérardmer and La Bresse (Tab. III). In all these newly created sites, the species developed vigorously and reached in a few years areas of more than 10 m<sup>2</sup>. In one of them, it nevertheless disappeared in the last years following habitat destruction.

All these sites correspond to weakly mineralized, acidic to neutral and clearly oligotrophic waters. *Calla* occurs in peaty pioneer habitats (with *Menyanthes trifoliata* L. and *Comarum palustre* L.) on pond borders or in *Alnus* forests (Tab. IV).

TABLE III

*Current and recent localities of Calla palustris in the southern Vosges, classified following the year of first data*

Site n°	Location	Altitude	Commune	Origine	Author and year of 1 <sup>st</sup> data	Area size	Habitat
11	Retournemer lake	770 m	Xonrupt-Longemer	Natural	Godron, 1843	4	Peatbog and <i>Alnus</i> forest
12	Quarry	790 m	Gérardmer	Introduced 1965	Ragué, 1965	3	Pond
13	Belbriette pond	810 m	Xonrupt-Longemer	Introduced 1980	Ragué, 1980	3	Pond border
14	Martimpré pond	790 m	Gerbépal	Introduced 1980	Ragué, 1980	4	Pond border
15	Quarry	660 m	Gérardmer	Introduced 1980	Ragué, 1980	† in 2006	Pond border
16	Faignes-sous-Vologne pond	920 m	La Bresse	Introduced 1980	Ragué, 1980	3	Pond border
17	Longemer lake	730 m	Xonrupt-Longemer	Natural extension	Ragué, 1990	3	<i>Alnus</i> forest
18	Beillard pond	610 m	Gérardmer	Introduced 1993	Bricault, 1993	4	Pond border

Area scale: † (plant disappeared), 1 (< 1m<sup>2</sup>), 2 (from 1 to 10 m<sup>2</sup>), 3 (from 10 to 100 m<sup>2</sup>), 4 (from 100 to 1000 m<sup>2</sup>), 5 (> 1000 m<sup>2</sup>).

TABLE IV

*Results of water analysis (sampling on 28/08/2006)*

Site n°	Location	pH	Conductivity µS/cm	NO3 mg N/l	NH4 mg N/l	PO4 µg P/l	Cl mg/l	SO4 mg/l	Alkalinity meq/l	Ca mg/l
11	Retournemer	7.0	134	0.21	0.01	2	29.6	3.5	0.28	5.3
18	Belbriette	6.5	24	0.13	0.03	4	1.4	2.0	0.14	2.3
17	Longemer	6.4	38	0.10	0.01	2	6.1	2.6	0.09	1.7
14	Martimpré	6.6	51	0.00	0.00	9	8.2	3.0	0.16	3.1
12	Quarry	5.3	22	0.30	0.11	31	1.1	1.4	0.07	1.6
18	Beillard	6.1	108	0.02	0.02	11	25.6	1.5	0.13	3.3

## DISCUSSION

On the whole, after a strong decrease in the 19<sup>th</sup> and first half of the 20<sup>th</sup> centuries (only 4 remaining locations at the mid of the 20<sup>th</sup> century), a recovery of *Calla palustris* occurred during the second half of the 20<sup>th</sup> century, bringing to 16 the current amount of locations (9 in the northern and 7 in the southern Vosges).

In the northern Vosges, the increase may correspond, in all sites, to a natural extension, following land abandonment and nature protection in these areas. This natural extension probably results from the aquatic dissemination of rhizome fragments from upstream to downstream. In the case of new locations not situated downstream of older ones, wetland birds may have played a role.

In the southern Vosges, the increase may result from natural extension for the Longemer site and is clearly linked to the human introduction of plants gathered in the Retournemer lake for the other sites.

The success of such natural and man-induced recovery of *Calla palustris* in the Vosges mountains can be related to different causes : (1) the wide ecological amplitude of the species, permitting its development in oligotrophic and acidic wetland habitats as well as in mesotrophic and more neutral habitats, (2) its large vegetative dissemination abilities by water and capacities to colonize newly created habitats (Eber, 1983), (3) the protection of wetlands and creation of new suitable habitats. This species therefore has to be regarded as a CSR species *sensu* Grime (1979), i.e. a competitive, stress-tolerant and ruderal species. These characteristics explain its recovery success.

*Calla palustris* can thus be considered in the Vosges as a “blue list species”, i.e. a threatened species with increasing abundance, as defined by Gigon & Langenauer (1998) and Gigon *et al.* (2000). This extension may go on in the following years and decades provided that this plant species will not be affected by climate change.

*Calla palustris* has also successfully been introduced in 1933 in a peatbog in the Jura Mountain (Ferrez *et al.*, 2001). In Belgium, *Calla palustris* has also been introduced from commercial provenance in some ponds (Saintenoy-Simon & Duvigneaud, 1994, 1998). But this kind of introduction of probably different genetic source has not to be promoted (Lambinon, 1994).

## ACKNOWLEDGEMENTS

I am grateful to Jean-Christophe Ragué, Jean-Claude Génot, Sébastien Morelle and Damien Pujol, who gave me information about newly discovered or created locations of *Calla palustris*. I also thank Philippe Rousselle, who performed water analysis.

## REFERENCES

- BERHER, E. (1876). — Catalogue des plantes vasculaires du département des Vosges. *Annales de la Société d'Émulation du Département des Vosges*, 15: 83-342.
- DANTON, P. & BAFFRAY, M. (1995). — *Inventaire des plantes protégées en France*. Nathan, Paris.
- DE SLOOVER, J., GOOSSENS, M. & LEBRUN, J. (1979). — Un groupement à *Calla palustris* en Ardenne. *Colloques phytosociologiques*, 7 : 203-212.
- EBER, W. (1983). — Untersuchungen zur Populationsbiologie von *Calla palustris* L. *Tuexenia*, 3: 417-421.
- ENGEL, R. & KAPP, E. (1961). — Les Vosges du Nord. *Bull. Soc. Bot. France*, 106: 105-111.
- ENGEL, R., MULLER, S. & WOLFF, P. (1979). — Contribution à l'étude de la flore des Vosges du Nord. *Bull. Soc. Hist. Nat. Moselle*, 42 :105-111.
- FERREZ, Y., PROST, J.F., ANDRÉ, M., CARTERON, M., MILLET, P., PIGUET, A. & VADAM, J.-C., (2001). — *Atlas des plantes rares ou protégées de Franche-Comté*. Naturalia Publications, Turriers.
- GÉRARD, F. (1890). — Notes sur quelques plantes des Vosges. Additions et Rectifications. *Revue de Botanique*, 1890: 51-240, 449-471.
- GIGON, A. & LANGENAUER, R. (1998). — Blue data books – an encouraging new instrument for restoration and conservation. *Appl. Veget. Sci.*, 1: 131-138.
- GIGON, A., LANGENAUER, R., MEIER, C. & NIEVERGELT, B. (2000). — Blue lists of threatened species with stabilised or increasing abundance – a new instrument for conservation in Switzerland. *Cons. Biol.*, 14: 402-413.
- GODRON, D.A. (1843/44). — *Flore de Lorraine*. Grimblot, Nancy.
- GODRON, D.A. (†) (1883). — *Flore de Lorraine* (3<sup>rd</sup> ed published by Fliche P. and Le Monnier G.). Grosjean, Nancy.
- GRIME, J.P. (1979). — *Plant strategies and vegetation processes*. Wiley, Chichester.
- KAPP, E. (1962). — Espèces et stations nouvelles de la Flore de l'Alsace et des Vosges. *Bull. Assoc. Philomath. Alsace Lorraine*, 11: 179-214.
- KAPP, E. (1967). — Contribution à la connaissance de la flore d'Alsace et des Vosges, 2<sup>ème</sup> série. *Bull. Assoc. Philomath. Alsace Lorraine*, 13: 237-255.
- KIRSCHLEGER, F. (1857). — *Flore d'Alsace et des contrées limitrophes*, vol. 2. Baillière, Strasbourg.
- KORNECK, D., SCHNITTLER, M. & VOLLMER, I. (1996). — Rote Liste der Farn- und Blütenpflanzen (*Pteridophyta* und *Spermatophyta*) Deutschlands. *Schriftenreihe für Vegetationskunde*, 28: 21-187.
- LEMASSON, C. (1920). — Guide du botaniste herborisant au Hohneck et aux environs de Gérardmer. *Bull. Soc. Sci. Nancy*, série 4, 1:79-109.
- MEUSEL, H., JÄGER, E., & WEINERT, E. (eds) (1965). — *Vergleichende Chorologie der zentraleuropäischen Flora*. Fischer, Jena.
- MOUGEOT, J.B. (1836). — Considérations générales sur la végétation spontanée des plantes phanérogames du département des Vosges. *Annales de la Société d'Emulation du Département des Vosges*, 2: 573-631.
- MOUGEOT, J.B. (1845). — Considérations générales sur la végétation spontanée (phanérogame et cryptogame) du département des Vosges. Pp 163-516 in: H. Lepage & C. Charton (eds). *Statistique du département des Vosges*. Peiffer, Nancy.
- MULLER, S. (1977). — Note sur la répartition de *Calla palustris* L. *Soc. Hist. Nat. Moselle, Activités*, 1977: 23-24.
- MULLER, S. (2006). — *Les plantes protégées de Lorraine. Distribution, écologie, conservation*. Biotope, Mèze.
- OBERDORFER, E. (2001). — *Pflanzensoziologische Exkursionsflora für Deutschland und angrenzende Gebiete*. 8th. ed. Ulmer, Stuttgart.
- OLIVIER, L., GALLAND, J.P. & MAURIN, H. (eds) (1995). — *Livre rouge de la flore menacée de France. Tome 1 : Espèces prioritaires*. Collection Patrimoines Naturels, 20. Muséum National d'Histoire Naturelle, Paris.
- SAINTENOY-SIMON, J. & DUVIGNEAUD, J. (1994). — À propos d'espèces introduites dans les étangs. *Adoxa*, 3: 11-13.
- SAINTENOY-SIMON, J. & DUVIGNEAUD, J. (1998). — Les plantes aquatiques ou palustres introduites. L'étang de Vieux-Barse dans la vallée du Hoyoux. *Adoxa*, 20/21: 35-40.
- SCHULTZ, F.W. (1846). — *Flora der Pfalz*. Richter, Pirmasens.
- SEBALD, O., SEYBOLD, S., PHILIPPI, G. & WÖRZ, A. (1998). — *Die Farn- und Blütenpflanzen Baden-Württembergs*. Bd 8. Ulmer, Stuttgart.