A SURVEY OF *ULMUS LAEVJS* IN FLANDERS (NORTHERN BELGIUM)

Kristine VANDER MIJNSBRUGGE*, An VANDEN BROECK and Jozef VAN SLYCKEN
Institute for Forestry and Game Management, Gaverstraat 4. B-9500 Geraardsbergen, Belgium
(* Author for correspondence ; e-mail : kristine.vandermijnsbrugge@inbo.be)

ABSTRACT. -This study reports on the growth sites of *Ulmus laevis* Pallas in Flanders, Northem Belgium. The sites reported by former authors were reviewed and six newly discovered sites in Flanders are described, including population size and habitus. All together, a summarising picture of the distribution of this rare tree species in Northem Belgium is drawn. Gene conservation strategies are discussed.

KEY woRDS. — *Ulmus laevis.* conservation, Dutch elm disease, Flanders.

INTRODUCTION

Ulmus laevis Pallas. the European white elm, is a broad-leaved riparian tree species with a centra) and eastern European distribution and one of the three indigenous elm species in Belgium, next to *U. minor* Mill. and *U. g/abra* Huds. (LAMBJNON *et al.* 1998). Along with the American elm (*V. americana* L.), *U. laevis* belongs to the section *Blepharocarpus,* whereas the other two European elm species, *U. glabra* and *V. minor.* belong to the section *Ulmus. U. laevis* does not easily hybridise with the other European elm species, and it is self-incompatible (MJTTEMPERGHER & LA PoRTA 1991). It tolerates wet soils and periodic flooding, and typically occurs in damp Jow-lying areas and as a component of riparian forests (WHJTELEY 2004). In Western Europe. deforestation and drainage of flood plains for agriculture and industry have severely diminished the area of suitable habitat for *U. laevis.* Habitat fragmentation is a major threat for the mostly marginal populations (COLLIN *et al.* 2000, GooDALL-COPESTAKE *et al.* 2005). Genetic studies carried out in Finland and Sweden. at the northern fringe of its range. U.[.1-gest that genetic drift may have caused substantial differentiation among the small populations of *V. laevis* (MATTILA & VAKKARJ 1997, WHJTELEY 2003, WHITELEY 2004).

Although *V. /aevis* is susceptible to Dutch elm disease <DED), caused by the fungal agent *Ophiostoma novo-ulmi*, it is not thought to be in immediate danger from the disease (WHITELEY 2004). Experiments with elm bark beetles (*Scofytus scohtus* and *S. multistriatus)* acting as vèctors for the fungal pathogen, showed that *U. laevis* is far less attractive for the beetles than *U. minor* (SACCHETTJ *et al.* 1990, WEBBER 2000). In contrast to the other *Ulmus* species. no repon exists of *V. /ael'is* in Flanders affected by DED in natura) conditions. Therefore, there is a raising interest from foresters and land managers to plant the species. Conservation of *U. /aevis* is of ecological as well as economie importance. The trees

serve as habitats for other organisms. are highly valued as landscape trees and produce high-quality wood (WHJTELEY 2004).

In the atlas of the Belgian and Luxembourg flora (VAN ROMPAEY & DELVOSALLE 1972) *V. /aevis* is totally absent in Flanders. LAMBINON *et al.* (1998) did not mention any growing sites either. A Jack of knowledge of the species most probably i the main reason why it has been overlooked in most vegetation surveys in the past. Recently. the distribution range in Europe has been published on the web. incorporating several recently described growth sites in Flanders (http://www.ipgri.cgiar.org/networks/euforgen).

A global inventory of autochthonous woody plants in Flanders is being carried out under the authority of the Forest and Green Area Division of the Flemish Community since 1997 (MAES & RöVEKAMP 1998. MAES & RöVEKAMP 2000. MAES *et al.* 2003. ÜPSTAELE 2001. RövEKAMP & MAES 1999, RövEKAMP & MAES 2000, RöVEKAMP *et al.* 2000. VANDER MIJNSBRUGGE 2003), following an inventory method based on MAES (1993) (see Material and methods). Because a few decades ago *V. laevis* was still unknown in Flanders (VAN ROMPAEY & DELVOSALLE 1972). these fairly recently published inventories urged the elaboration of a detailed overview of the remaining populations in Flanders.

Here. we report on six newly discovered growth sites of *Ulmus /aevis.* In addition. the sites described in the inventories of autochthonous trees and shrubs in Flanders (MAES & RövEKAMP 1998, MAES & RövEKAMP 2000, MAES *et al.* 2003. ÜPSTAELI: 2001, RöVEKAMP & MAES 1999. RövEKAMP & MAES 2000, RövEKAMP *et al.* 2000) were revisited by the authors and outlined in the same way. An overall and summarizing picture of the distribution of this rare tree species in Flanders is thus drawn. We also discuss strategies for gene conservation.

MATERIAL AND METHODS

IDENTIFJCATIO!\ OF *U. LAE\11:*

For the identification of *U. laevis.* LAMBINO!\ *ei al.* 1998 was followed. The stalked flowers and nut of *U. laevis* make the pecies unambiguously distinguü•hable from *U. minor* and *U. glaiJra* (LAMBINON *et al.* 1998). Also, the leaf shows a typical soft velvety lower surface (LAMBINON *et al.* 1998).

METHOD OF INVENTORY OF Al'TOCHTHONOUS TREES AND SHRUBS

We followed the method of MAES (1993). First, old forests were located on topographical maps. using historica] forest evolution maps (DE KEERSMAEKER *et al.* 2001). These maps differentiate forested and non-forested areas, but no indication of tree species can be deduced. Together with information on flora, soil condition and geography. sites were chosen to be visited in the field. Once in the field. several criteria were used to evaluate autochthony (MAES 1993). Criteria regarding the site were : (i) the site was afforested on the Ferraris map (l8th century) or on other historica! topographic maps (DE KEERSMAEKER *et al.* 2001) ; (ii) the site appeared to have remained und1sturbed ; (iii) the ecological conditions were similar to the conditions in the natura! area of prevalence of the species ; (iv) plant species indicative of old forest and ancient, undisturbed woodlands (TACK *et al.* 1993J were present in herbaceous, shrub or tree layer and (v) the site was Jocated within the natura) distrihution range of the species. Important criteria regardin!! the tree or shrub were : (i) the tree or shrub is no cultivated variety and (ii) is old.

As the inventory Jacked some details, such as the habitus of the trees or shrubs. the growth sites where *U. laevis* was described were revisited by the authors and reported in detail (Table 1). Through this inventory. knowledge on identification of *U. laevis* began to spread among botanists and other field werkers. Other new growth sites. not yet published. were recorded by personal communication to the author.

RESULTS

All sites where *V. luevis* trees were discovered were visited by the authors and described in detail. The available data are summarised in Table 1.

In De Panne. the white elms grew in a tiny strip of forest on the inland edge of the dunes. The coppice stools were scattered along a small naturally meandering stream. The circumference at soil level of most stools averaged between 2 and 3 m. Because of the strong h1storical human influence in the dune vegetation in Flanders, the autochthony of this site i questionable.

[illegible]

TABLE 1

Populations and relic individuals of U. laevis *in Flanders (new findings from this study are in italics)*

Locality	n° of individuals and / or coppice stools (1)	(2)	landscape element	habitus	circumference (3)	dm spp. (4)	reference
[illegible]	15		*edge of forest*	*pollards*	*up to 1.5 m*		*this study*
Loeteert?			forest / edge	pollards	up to 1.5 m		
8mkel	8	-	*edge of meadow*	*pollard*	*to R() c m*		*this study*
Ruisbrede / Sint-Lievens Houtem	2 / 1		edge of small forest in valley	*one pollard* and *one coppice*	0.6 m *(pollard)* and 2.5 m *(coppice)*		Maes & Rövekamp 1998
Sint-Ulrichs-Kapelle 2	*q*		*edge of forest*	*7 pollards and 2 normal trees*	*up to 1.1 m*		*this study*
Lerwse? 1		1/h	2 in hedge, 1 in forest	2 *pollards*, 1 coppice stool	pollards up to 3.5 cm, coppice of 5 m		Maes *et al.* 2003
Zandvliet 2	2			*coppice*	*2.5*		*this study*
Zandhoven	5		edge of small forest	coppice	up to 2 m		Maes *et al.* 2003
Lille	10	a/h	forest, small	normal tree	one tree of 1.2 m, others smaller than 80 cm		Maes *et al.* 2001
Bertem (5)	1		large forest edge	stool	1		Opstaele 2001
Hasselt			*large forest*	*pollard*	*1.6 m and 2.2 m*		*this study*
Heers	1	a/h	hedge row	coppice *and*	up to 4.5 m		Opstaele 2001

I k-ers 2	I'i	;j;;-	small fnrrst	low po'!ards coppice and norm_11_l_ti:_e	coppicr up tn 8 111. normal trees up to 2 m	urn	Opstaele 2001
1[re'" 1	7	. an'	s111;1JI fnrrst	coppiec a nd nonna! trees	coppicr up tn 4 111. nnnnal trees up tn 1.> 111	11111.ug	OJ"tarle 2flfl l
Hccrs 4	*I()*	a/h	forcst and forcst cdgc	norma 1 trees	*11p to* 2 111	um. *11g*	Opstaclc 2001

Notcs. (1) Both an individ ual and a coppiec stool rcprcscnt one genotype. The different sterns bclongi ng to one coppicc stool are not measurcd individually and are also not indieated as separate individuals. *(2)* Q11otat inn for authochthony: a. autochthonous with certainty, b. probably autochthonous. (3) Circu mfercncc is measured at brcast hcight for normal trees. Fnr cnppice stools the cirrnmfcrence is measured at soil level. surrounding all individual sterns belongi ng to one and the same stool. When more than 2 indivicl11als and/or stools are present. only the largest circumference is indicatecl. (4) Presence of other elm species in immediate neighhourhood: 11111. *U. minor;* ug. *U glohm;* uh. *U.* x *lwllandica.* (5) Not fou ncl oi1 a revisit of the site by the authors in the winter of 2003-2004.

In Ploegsteert. the white elms grew at *the* bottom of a forested slope. next to a road. There are no streams in the immediate neighbourhood. but the forested slope is mapped as a historica] forest on the Ferraris map *(DE* KEERSMAEKER *er al.* 2001) and holds many indications of old and undisturbed forested sites. For instance. next to the white elm we found the extremely rare rose species *Rosa sty/osa* and *R. micranTha.*

The white elm stools in Ruislede were found in an inundation area of a small stream. Although the circumference of the elm pollards indicated a reasonable age. no large stools or pollards of other woody species were present in the neighbourhood. The area is mapped as a historica] forest.

In Brakel. the five recorded individuals were pollarded trees. They occurred in two clump . with about 1 m het ween the sterns. These t wo dumps possibly represent only two genotype . The trees grew on a small slope *(a* difference oJ 1 m in altitude) that separated the inundation area of a small stream, now planted with poplars. and a higher, Jevelled meadow. The site is pan of a relatively large historica] forest.

In Sint-Lievens Houtem. white elms were found at two sites l km apan. One location is *a* hurnid valley of a small stream where one old coppice and a probably younger pollard were present. Other elm species were present in this valley. including the hybrid *U.* x *hol/andica.* The second site is located along a hillside. Here. the pollarded elm were planted on a former edge between a meadow and a forest. Other species were present in this row. including *Craraef!U S monogyna* <*not* pollarded) and *Carpinus betulus* (pollarded). The meadow is novplanted with poplars and the pollard row of elms **i** suffering from shade and the Jack of maintenance. A few pollards are already torn apart.

In Zoersel. several white elms grew in a large valley that consists of a historica] mosaic oJ forested strips. wood hanks and humid meadows. Most probably, pan of the area were naturally inundated on a regular basis. which makes the site a very likely nat ura) habitat for white elm. The circumference o1 one of t he pollarded elm (3.75 m) indicate an old age.

Zandhoven is cloe to Lille. a neighbourin village of Zoersel. Here the white elms grew on the bank of a naturally meandering stream, which is pan of a historica] forest. It concerns large stools (circumference up to 7 m) indicating an old age.

In Lille. one old elm and several younger white elm trees grew scattered in a small historica] forest that is transected by a small stream. Several of the young trees grew funher than 10 m apan from the older tree. Possibly. the younger trees represent natura) rejuvenation.

In Hasselt, two big pollard were recorded in the middle of a large forest complex. Both grew at a different border of a forest stand where small streams are present, possibly man-made to irrigate the stands.

In Heers white elms grew at several sites. The high number of recorded trees *<68)* suggests that this area is possibly the most valuable relic population in Flanders. Pollards. coppice and normal trees are present in small J orest patches. séattered in between larger agricult ural fields.

ln all. 130 white elm trees that have a possible autochthonous status were recorded in Flanders (Table 1). They grew in forests, forest edges and wood banks that are mostly Jocated on stream banks or in or near inundation areas. No growth site was present along the main rivers Schelde. Ijzer or Maas. Human influence was prominent in many cases through pollarding (7 of l 6 sites. Table 1) and coppicing < 10 of 16 sites. Table 1). Coppice stools were measured with a circumference at soil level up to 8m <Table 1). Low pollards in Heers reached a circumference of more than 4 m. whereas the pollards in Zoersel. pollarded at a height of 2 m. had a circumference at breast height of 3.75m <Table l 1.

DISCUSSlOJ'\

The results of the survey clearly reveal that *U. /aevis* is a rare and endangered species in Flanders. Nearly all natura] riparian forests have di sappeared along the main rivers resulting in the extinction of typical natura] habitat. A a conseyuence. nat ura] populations of *U. laevi1* are mostl y red uced to relic individuab. The sit uation in Flanders is similar to Germany. a reponed by MACKENTHLTN (2004) : most *V. luni.1* trees were found in restricted habitats within agricult ural Jandscapes.

Here. the term autochthonous is used to indicate elms that regenerated spontaneousl y or that were reprod uced with Jocal material. counting from the Jast ice age (HEYBROEK 1992). Most remnant populations of *V. laevis* in Flanders are considered aut ochthonous in the inventory (guotation for autochthony i n Table 1). Apa11from other criteria to evaluate autochthony (see Material and methods). the large circumference of coppice stools of *V. laevis* in Zandhoven and Heen (Table 1) are important criteria for the autochthonous guotation. Also. spontaneous nat ura] regeneration. another criterion that may i n dicat e autochthony. can be inferred from the population of Lille (Table 1). where one mature tree (circumference at breast height = 1.2 m) is surrounded by several you nger trees. Also. the different populations in Heers show a differentiation in circumference. including younger trees that most prohably were not planted and therefore indicate possi ble natura] regeneration. On the other hand. some characters of the populations indicate old cultural heritage rather than autochthony. Flanders is the western limit of the range and nearly all growth sites of *V. laevis* testify of human influence through coppice, pollarding and/or the presence in the immediate neighbourhood of *V. glabra* and *V. minor*. t wo species with different ecological reguirements (Table 1). Although these argu ments may question the autochthonous st a t us i n Flanders. the val ue of the remnant populatiom a> old cultural heritage is beyond dou bt.

The risk is apparent that the extremely low n umbers of trees in the remnant populatiom in Flanders may have resulted in genetic depauper;,. tion. Therefore, gene conservation i esential (JENSEN *et al.* 1999. CoLLJN 2003. GoODALL· CoPESTAKE *et al.* 2005). A clonal archive with grafted elms is currently being developed at the Institute for Forestry and Game Management. as a gene conservation programme. Because of thf reduced numbers of trees per population. all individuah are >ampled for grafting. except the larpe1 populatiom in Heers. for which only a subsamph is sufficient. The resulting living collect ion is a statie storape of genotypes. hut it opens po sihil i·ties for several more d vnamic conservation approaches. As grafting trials with summer cuttings showed reasonable success rates (data not shown), cuttings will be taken from the clonal archive as basic material for a seed orchard in the near future. The genetic variability in the offspring of the seed orchard will be used in new forestation and other plantings. It will also be possible to restock remnant populations with vegetatively propagated plants from selected clones from the archive from. for example, the same fluvial basin or from the neighbouring growth sites.

Future research will include a genetic survey of the *ex situ* collection. This should give more insight in the genetic diversity. which will enable fine-tuning of *in situ* conservation measures.

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