

**FORMAT FOR A PRA RECORD (version 3 of the Decision support scheme for PRA for quarantine pests)**

|   |   |  |   |
|---|---|--|---|
|   | European and Mediterranean Plant Protection Organisation                  |  |   |
|   | Organisation Européenne et Méditerranéenne pour la Protection des Plantes |  |   |
|   |   |  |   |
|   | <b>Guidelines on Pest Risk Analysis</b>                                   |  |   |
|   | <b>Lignes directrices pour l'analyse du risque phytosanitaire</b>         |  |   |
|   |   |  |   |
|   | <b>Decision-support scheme for quarantine pests Version N°3</b>           |  |   |
|   |   |  |   |
|   | <b>PEST RISK ANALYSIS FOR <i>LYSICHITON AMERICANUS</i></b>                |  |   |
|   | <b>HULTÉN &amp; ST. JOHN (ARACEAE)</b>                                    |  |   |
|   |   |  |   |
| <b>Pest risk analyst:</b>                           |   |  |   |
|   | <b>Revised by the EPPO<br/>ad hoc Panel on<br/>Invasive Alien Species</b> |  |   |
| <b>Stage 1: Initiation</b>                          |   |  |   |
|   |   |  | <p>The EWG was held on 2009-03-25/27, and was composed of the following experts:</p> <ul style="list-style-type: none"> <li>- Ms Beate Alberternst, Projektgruppe Biodiversität und Landschaftsökologie (<a href="mailto:b.alberternst@online.de">b.alberternst@online.de</a>)</li> <li>- M. Serge Buholzer, Federal Department of Economic Affairs DEA (<a href="mailto:serge.buholzer@art.admin.ch">serge.buholzer@art.admin.ch</a>)</li> <li>- M. Manuel Angel Duenas, CEH Wallingford (<a href="mailto:mdu@wpo.nerc.ac.uk">mdu@wpo.nerc.ac.uk</a>)</li> <li>- M. Guillaume Fried, LNPV Station de Montpellier, SupAgro (<a href="mailto:fried@supagro.inra.fr">fried@supagro.inra.fr</a>),</li> <li>- M. Jonathan Newman, CEH Wallingford (<a href="mailto:jone@ceh.ac.uk">jone@ceh.ac.uk</a>),</li> <li>- Ms Gritta Schrader, Julius Kühn Institut (JKI) (<a href="mailto:gritta.schrader@jki.bund.de">gritta.schrader@jki.bund.de</a>),</li> <li>- M. Ludwig Triest, Algemene Plantkunde en Natuurbeheer (APNA) (<a href="mailto:ltriest@vub.ac.be">ltriest@vub.ac.be</a>)</li> <li>- M. Johan van Valkenburg, Plant Protection Service (<a href="mailto:J.L.C.H.van.valkenburg@minlnv.nl">J.L.C.H.van.valkenburg@minlnv.nl</a>)</li> </ul> |
| <b>1 What is the reason for performing the PRA?</b> |   |  | <p><i>Lysichiton americanus</i> originates from the pacific coastal zone of Northwest-America and was imported into the UK at the beginning of the 20th century as a garden ornamental, and has since been sold in many European countries, including southern</p>  |

|   |     |   |
|---|-----|---|
|   |     | countries like Italy. It is now found in 11 European countries. The species has been observed to reduce biodiversity in the Taunus region in Germany. The species is recorded in other parts of the EPPO region, and might represent a threat to biodiversity. An initial EPPO PRA was performed and approved in 2005. After the proposal to list this species in the Directive 2000/29/EC, the European Food Safety Authority reviewed the initial PRA and made some comments. The initial PRA is therefore revised in the view of the EFSA comments and of information having become available after the initial PRA. |
| <b>2 Enter the name of the pest</b>         |     | <i>Lysichiton americanus</i> Hultén and St. John  |
| <b>2A Indicate the type of the pest</b>     |     | Wetland plant (marginal aquatic plant).   |
| <b>2B Indicate the taxonomic position</b>   |     | Kingdom: <i>Plantae</i><br>Class: <i>Liliopsida</i><br>Family: <i>Araceae</i><br>Subfamily: <i>Orontioideae</i><br>Synonyms: <i>Lysichiton camtschatcensis auct. non (L.) Schott</i><br><br>Prior to recognition of North American <i>Lysichiton</i> as a distinct species, the genus contained a single taxon: <i>Lysichitum. camtschatcensis</i> . This name (in several spelling variations) was previously applied to both Asian and American <i>Lysichiton</i> , and is now the valid name for Asian populations (FNA, 1993). See St. John H & Hultén E (1956).  |
| <b>3 Clearly define the PRA area</b>        |     | EPPO region   |
| <b>4 Does a relevant earlier PRA exist?</b> | Yes | EPPO (2005) PRA on <i>Lysichiton americanus</i> . Unpublished.  |

|  |                  |   |
|--|------------------|---|
| <b>5 Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?</b> | Yes, only partly | The present PRA consists in an update of the earlier EPPO PRA.  |
| Stage 2A: Pest Risk Assessment - Pest categorization   |                  |   |
| <b>6 Specify the host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants) present in the PRA area.</b>   |                  | <p>It has been found in wetlands including wet woodlands, lakeside, raised bogs, swamps, riverbanks, pond margins, in permanently wet soils, in alluvial forests, moorlands and wet meadows (Vanderhoeven <i>et al.</i>, 2007; Doyle &amp; Duckett, 1985; Alberternst &amp; Nawrath, 2002).</p> <p>The suitable habitats for the species present in the PRA area following the CORINE land cover classification (See Appendix 1): moors and heath land, inland wetlands (fens, bogs, wet woodlands and marsh areas), costal wetlands and continental waters (shoreline of the lake and banks of rivers).</p>  |
| <b>7. Specify the pest distribution</b>  |                  | <p><b>Native Range:</b><br/> <i>Lysichiton americanus</i> originates from the wetland areas in the north western pacific coastal zone of North America from south east Alaska to northern California. This plant is found from Kodiak Island and Cook Inlet, Alaska south through British Columbia, Washington, Oregon, and Northern California as far south as Santa Cruz County in California. Isolated populations are also found in north-east Washington, northern Idaho, Montana, and Wyoming (Hickman, 1993; FNA, 1993). More details are available from the Missouri Botanical Garden (2009) and also in Zipcodezoo (2009) and USDA (2009).</p> <p><b>Introduced range:</b><br/> <i>Lysichiton americanus</i> is recorded in 11 countries in Europe, but it is to be kept in mind that monitoring for this species is not systematic in EPPO countries.</p> <p><b>EPPO region</b></p> |

**UK: 198 sites, considered invasive at 2, 1 has been eradicated**

*L. americanus* was only reported from the British Isles including Ireland in the last edition of Flora Europaea (Tutin *et al.*, 1980). Within Europe, the highest numbers of established populations are found in Great Britain and Northern Ireland. *Lysichiton americanus* was first introduced in Europe for cultivation in Great Britain in 1901. The first records from the wild are from 1947 (Clement and Foster 1994). It was only recorded four times before 1970, 11 times until 1986, 159 times until 1999, 187 until 2002 (Preston *et al.* 2002) and 198 until 2006 (BSBI, 2009). In Northern Ireland, the species was recorded in 4 sites between 1970 and 1986, and after 1986, 15 sites have been recorded (Flora of Northern Ireland, 2004). The number of plants at each site remains unknown.

In Scotland it has been found near the in Perthshire where it is clogging water channels and colonising wetland ecosystems (Anon, 2006). It is also reported as clogging ponds and ditches in a tidal estuarine site at Tarbert Woods (Cox & Curtis Machin, 2008). See map in Appendix 2.

**Ireland: 24 sites, 2 considered invasive**

The first records from the wild come from Woodfield bog in 1930, it has been observed growing in vegetation with *Sphagnum* spp., *Aulacomnium palustre* (indicating nutrient enrichment) and *Betula pubescens* (Doyle & Duckett 1985). Established from 1960s (Peters, 1960; O'Mahony, 1975; Doyle & Duckett 1985, O'Malley 1996; Webb *et al.*, 1996, Preston *et al.* 2002) 24 sites are recorded up to 2009 (Reynolds, 2002; NBN 2008; BSBI, 2009) and the species is listed on the National Biodiversity Data Centre Website.

**Sweden: 29 sites, the species has not been spotted as invasive**

The species was introduced around 1975 as an ornamental plant (M Josefsson, pers. comm. 2004 in Klingenstein and Alberternst, 2006). In 2003, 29 sites were recorded in south and central Sweden (Larson, 2003). Examples are the rivulets Vinån and Fylleån in the province of Halland, Tveta in the province of Södermanland (Lenfors & Nilsson 1987) and in the province of Östergötland (Lind, 1988) in bogs and moist forests, where it propagates well and seems well established (A. Anderberg, pers. comm., in Klingenstein and Alberternst, (2006); Edqvist & Karlsson, 2007). Since then, no substantial information could be found on the species (M Josefsson, pers. comm., 2009).

**Germany: 6 sites, 1 invasive and 2 under eradication and 1 monitored**

Stands of *Lysichiton americanus* in the wild are quite rare in Germany, 6 sites are known: in the Taunus northwest of Frankfurt, near Koblenz, in the Eifel, in Düsseldorf, in the Harz and in the Western Ruhrgebiet. Most of the stands consist of a small number of plants. The Taunus population near Frankfurt is known to have been introduced deliberately by a gardener in the 1980s who planted a few individual plants in different places, mainly at the sources of streams and in swamps. The population of *L. americanus* was comprised of some thousands of large (>80 cm) plants and many thousands of small seedlings (estimate of all plants removed between 2001 and 2008 is 30,000-40,000 – pers. comm. Alberternst, 2009) (Korneck & Krause 1990, König & Nawrath 1992, Alberternst & Nawrath 2002; see Appendix 4). Only the stand of the species in Taunus is known to be invasive in Germany (B. Alberternst, pers. comm., 2009.), the other five populations are smaller:

- at about 20 plants in swamp forests in the Western Ruhrgebiet since 2002 where the population was first recorded in 1980. It has not spread as in the Taunus. (Fuchs *et al.* 2003; B Alberternst, pers. comm., 2009),
- 20 plants at two locations in the Harz near Elendstal (Herdam 1994a; 1994b; in 2005 have been successfully controlled; Dr. Christoph Schönborn, pers. comm. in Klingenstein and Alberternst, 2006),
- 10 plants in Pillebachtal in Düsseldorf since 2004 (Dr. Michael Luwe, Kempen, pers. comm. in Klingenstein and Alberternst, 2006),
- an unknown number of plants in Brexbachtal near Koblenz since the beginning of the 1990s (Fischer & Schausten 1994),
- and approximately 150 small plants in the Eifel (Rhineland) near Rom. (FloraWeb, 2006).

**Belgium: 3 sites**

Since 2006, a few plants have been recorded in 3 sites in the Meuse and Ardenne regions, where it was most probably planted (Vanderhoeven *et al.*, 2007, Branquart, *et al.*, 2007; E. Branquart, pers. comm., 2009). The first site where the hybrid species was observed is a small water course near an arboretum (see picture and distribution map at <http://ias.biodiversity.be/ias/species/show/13>). Other sites are near a pond, and another in a forest, but it is not known whether the hybrid or the species are present there. No

further spread has been observed, and the species is not considered a priority for action (E. Branquart, pers. comm., 2009).

**Norway: 3 sites**

Three sites in the south are reported, (Bratland *et al.*, 2000) where it probably was introduced in 1934. More than 200 plants have been recorded since 2001 in a swamp on Tromøy island near Arendal, where two plants have been planted around 1960 (Åsen, 2002). It has also been reported as garden escape in Bergen on the West coast of Norway (Lid & Lid 1994).

**Finland: 2 sites**

2 sites have been recorded since May 2005 in a Natura 2000 area, one close to a stream quite far from human settlements in the Pohja commune (between Karis and Salo, southern Finland) (Harry Helmisaari, pers. comm. 2005) and another on the shore of Lake Pääjärvi and Porvoo (Uusimaa) (Ryttäri, 2006, see <http://www.ymparisto.fi/default.asp?contentid=200705&lan=EN>).

**France: 2 sites**

In France, *L. americanus* was first recorded in 1995 along the river Furan in the massif of Mount Pilat (Delaigue, 2001). The plant was noted to have probably escaped from the garden of a collector located in the village at the source of the river Furan. However, the species has been known locally in the wild for twenty years but has probably been present for over 40 years (J.-M. Tison, pers. comm., 2009). In this location, *L. americanus* plants are rare, isolated and do not survive for a long time. In 2006, there were between 15 and 20 individuals spread over 2.7 km (Conservatoire Botanique national du Massif central, pers. comm., 2009) suggesting a gradual shift of the plant downstream, while upstream, where the plant was originally known, there was only one individual remaining (J.-M. Tison, pers. comm., 2009). Between 2006 and 2008, the situation seems to be stable with no impact reported on the ecosystem and indigenous species.

In 2005, a second location of *L. americanus* was found in the Haute-Vienne department in a hygrophilous wood (willow) along a stream dominated by *Salix acuminata* called Nouhaud at the bottom of a pond (Lebreton, 2007). In this second location, the plant is

more invasive with an increasing number of individuals recorded: 4 in 2005, 12 in 2006 and 2007 and 32 in 2008, of which the majority were seedlings (Lebreton, pers. comm., 2009). The origin of the plant is not known, however, *L. americanus* has been cultivated for 20 years in Limoges botanical garden about 17 km away). The owners of the land have been contacted pending a possible eradication, they have pledged to cut spadices before seed production. In 2008, the Regional Scientific Board of natural heritage of Limousin has placed the species on a blacklist of invasive species and the French Ministry of Ecology has been alerted.

**Netherlands: 2 sites, of which one under eradication**

In 2004, the plant was reported by a botanist as forming a dense stand in a willow thicket in Brummen (Gederland), the Netherlands. After a survey, this was the only location found and it was considered a remnant of a nursery for water plants situated originally on the same site, but abandoned in the 1950s. There has been an eradication action at this site (Rotteveel, 2007). As a result of publicity raised by this action, new reports and sighting of *L. americanus* in urban areas or along watercourses near housing areas have been received (Waarneming.nl, 2009). The second report of *L. americanus* in natural areas was in a forest in Limburg (2008) (Johan Valkenburg, per. comm., 2009). Action will be taken in early 2009 (J van Valkenburg, pers. comm., 2009).

**Denmark: 1 site**

*L. americanus* was first observed in the wild in the 1950s. From this original site (Vestbirk in Jutland) the species has apparently dispersed via the waterways 20 km downstream, and now is well established at this site since 1981 (Wild about Denmark, 2009).

**Switzerland: 1 site eradicated**

In May 2003 a stand of about 100 plants of *L. americanus* was discovered in the raised bog of Meienmoos in the canton of Berne and reported to the Office for Agriculture and Nature from the canton of Berne. It is not known by which pathway *L. americanus* reached the raised bog but it is very likely that it was deliberately planted. A successful eradication action was undertaken (Jörg, 2009). See map at: [http://www.cps-skew.ch/francais/inva\\_lysi\\_ame\\_f.pdf](http://www.cps-skew.ch/francais/inva_lysi_ame_f.pdf)

|  |     |  |
|--|-----|--|
|  |     |  |
| <b>8. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?</b>                               | Yes | <p>The genera <i>Lysichiton</i> contains two morphologically distinct species that are easily separated on the basis of spathe colour. <i>L. americanus</i> has yellow spathe and <i>L. camtschatcensis</i> has white spathe. <i>L. camtschatcensis</i> is also smaller (FNA, 1993; Ohwi, 1984).</p> <p>The species is unlikely to be confused with <i>Symplocarpus foetidus</i> which has usually purplish spathes (Ohwi 1984), or <i>Arum maculatum</i> (Lansdown, 2008) which may occur in similar habitats.</p>  |
| <b>9. Even if the causal agent of particular symptoms has not yet been fully identified, has it been shown to produce consistent symptoms and to be transmissible?</b> |     | Not applicable   |
| <b>10. Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?</b>   | Yes | <p><i>L. americanus</i> has deleterious impacts on biodiversity in Germany and possibly in different EPPO countries (Alberternst, pers. Com 2009, presentation in Appendix 4)</p> <p>In Switzerland the species has established recently and was included in 2004 on the non-official black List and eradication in 2008 (A list of invasive alien plants of Switzerland that actually cause damage in the areas of biodiversity, health, and/or economy - The establishment and the spread of these species must be prevented)) (CPS/SKEW, 2006).</p> <p>In Germany it is included in the German Internet Handbook of invasive plants (Neoflora website) and control measures began in the Taunus region (EPPO, 2004). Although very rare, Klingenstein &amp; Schepker, (2005) considered this plant problematic in Germany.</p> <p>In Ireland <i>Lysichiton americanus</i> is considered a problematic aquatic species and is listed on the National Biodiversity Data Centre Website, 2008.</p> <p>In the Netherlands, the Dutch government has decided to take action to eradicate it (Meijden and Rotteveel, 2006).</p> <p>In Belgium, The ISEA protocol aiming at drafting alert lists for this country ranked the dispersal capacity (both natural and human assisted) of this plant as medium (<a href="http://ias.biodiversity.be/ias/species/show/13">http://ias.biodiversity.be/ias/species/show/13</a>).</p> |



|  |     |   |
|--|-----|---|
|  |     | In its native area, <i>L. americanus</i> is not considered a problem.   |
| <b>11. Does the organism have intrinsic attributes that indicate that it could cause significant harm to plants?</b>   | Yes | The plant has large thick leaves, with stout petioles up to 40 cm long, and leaf blades measuring up to 135 cm long and 70 cm wide (FNA, 1993), which exclude light and thus affect biodiversity in ecologically sensitive wetland habitats by reducing under storey plant species and numbers. |
| <b>12 Does the pest occur in the PRA area?</b>   | Yes | See 7 above.  |
| <b>13. Is the pest widely distributed in the PRA area?</b>   | No  | Although <i>L. americanus</i> is recorded in 11 countries as of 2009 (see question 7), its distribution remains very limited in these countries (except in the UK). See question 7.   |
| <b>14. Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation or both)?</b>                             | Yes | Wetlands and damp margins of water bodies are present in the EPPO region and most are categorised as protected habitats under Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (See Appendix 1).<br>See question 6.               |
| <b>15. If a vector is the only means by which the pest can spread, is a vector present in the PRA area? (if a vector is not needed or is not the only means by which the pest can spread go to 16)</b>                                   |     | Not applicable  |
| <b>16. Does the known area of current distribution of the pest include ecoclimatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?</b> | Yes | The plant is already established in part of the PRA area.   |

|   |     |  |
|---|-----|--|
| <p><b>17. With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) through the effect on plant health in the PRA area?</b></p> | Yes | <p>In its introduced range, it is occasionally considered to reduce biodiversity in wetland habitats (see question 11).<br/> It can displace, and cause local extinction of rare mosses species (e.g. different <i>Sphagnum</i> species) and vascular plants (e.g. <i>Carex echinata</i>, <i>Viola palustris</i>, and orchids) (König &amp; Nawrath, 1992, Alberternst &amp; Nawrath, 2002).<br/> In the Taunus in Germany, studies have shown a reduction in species number of more than 50% in dense stands (B Alberternst, pers. comm., 2009; see figures in Appendix 4)</p> <p>Costs arise from eradication and control campaigns.</p> |
| <p><b>18. This pest could present a risk to the PRA area.</b></p>   | Yes | <p>There is a risk of establishment <i>L. americanus</i> in specific natural habitats.</p>   |
| <p><b>19. The pest does not qualify as a quarantine pest for the PRA area and the assessment for this pest can stop.</b></p>  |     |  |

## Section 2B: Pest Risk Assessment - Probability of introduction/spread and of potential economic consequences

| Question  | Rating + uncertainty | Explanatory text of rating and uncertainty   |
|---|----------------------|--|
|   |                      | <p><b>Note: If the most important pathway is intentional import, do not consider entry, but go directly to establishment. Spread from the intended habitat to the unintended habitat, which is an important judgement for intentionally imported organisms, is covered by questions 1.33 and 1.35.</b></p>   |
| <p><b>1.1. Consider all relevant pathways and list them</b></p> |                      | <p>Pathways are:</p> <ul style="list-style-type: none"> <li>- <u>Intentional import as an ornamental plant for use outdoors</u> <ul style="list-style-type: none"> <li>a. <i>Imports</i></li> </ul> </li> </ul> <p>The first intentional introductions of the plant as an ornamental to Europe are reported at the beginning of the 20th century in the UK.<br/>The actual known origins for import are:</p> <ul style="list-style-type: none"> <li>- meristem tissue culture production in Indonesia (J van Valkenburg, pers. comm., 2009)</li> <li>- unknown imports of young plants from North-America</li> <li>- internet sale of seeds and young plants within and from outside the EPPO region. See: <ul style="list-style-type: none"> <li>- <a href="http://www.kevockgarden.co.uk/store/product.aspx?id=3151">http://www.kevockgarden.co.uk/store/product.aspx?id=3151</a></li> <li>- <a href="http://www.wyevale.co.uk/Lysichiton-Americana---Skunk-Cabbage-+3lt/0850039051,default,pd.html">http://www.wyevale.co.uk/Lysichiton-Americana---Skunk-Cabbage-+3lt/0850039051,default,pd.html</a></li> <li>- <a href="https://www.gardens4you.co.uk/index.php?/Waterplants/Lysichiton-americanus.html">https://www.gardens4you.co.uk/index.php?/Waterplants/Lysichiton-americanus.html</a></li> </ul> </li> </ul> <p>109 commercial websites have <i>L. americanus</i> seeds listed as available in their catalogues.</p> <p>A survey in Switzerland highlighted that <i>Lysichiton americanus</i> was either produced in Switzerland, or imported from the Netherlands (S Buholzer, pers. comm., 2009). In Germany, few nurseries produce the plant themselves, and the majority buy from 2 production sites in Germany. A few import small plants from the Netherlands and Belgium (G Schrader, pers. comm., 2009).<br/>In the Netherlands, there were no records of imports of <i>L. americanus</i> from outside EU during 2006-2007 (EPPO 2009). There are no records of import of <i>L. americanus</i> as an</p> |

| Question | Rating + uncertainty | Explanatory text of rating and uncertainty   |
|----------|----------------------|--|
|          |                      | <p>aquatic plant in Austria, Estonia, Latvia, Hungary and Czech Republic (EPPO, 2009), but this species might be recorded under other commodity types than aquatic plants.</p> <p>In the Netherlands, annual sales amount to 20.000 -40.000 plants and exports will be roughly the same.</p> <p>Plants on sale are 1-2 years old, and it takes a few more years for these to start producing flowers. Because of the extensive fleshy root system which is prone to damage and resulting in adverse effects on further plant development, plants of flowering size and age are too bulky and too expensive for trade purposes.</p> <p>The volume in trade for <i>L. camtschatcensis</i> is comparable to <i>L. americanus</i>. See Q 1.33 on spread helped by human activities for data on trade within the EPPO countries.</p> <p><i>b. Transfer from intended habitats to unintended habitats</i></p> <p>The transfer to unintended habitats may occur through:</p> <ul style="list-style-type: none"> <li>- escape from ornamental plantings, particularly if there is a stream in connection with natural areas in the direct vicinity of the plant. The species can spread both locally or through long distances by this pathway. In Denmark, the plant was found in 1950s in a garden a few meters from a lake, which is connected to a river. In 1981 it was found 20 km downstream of the garden and this is the first "wild" record from Denmark. The plant is now found in 1 locality (E Swart, pers. comm., 2009). In France, it is assumed that the plant escaped from a private garden situated near the source of the river where the species occurs downstream (Delaigue, 2001). In the UK, it is assumed that where plants were originally planted alongside streams, significant downstream spread has occurred at most sites (Newman, pers. comm., 2009). In Ireland, it has also been recorded to have escaped from ornamental plantings since the middle of the 1950s (Peters, 1960; Doyle &amp; Duckett, 1985; Mahony, 1975).</li> <li>- direct planting into natural sites: this occurred in the Taunus where a gardener planted or sowed the species in different places (König &amp; Nawrath, 1992; B Alberternst, pers. comm., 2009), in Switzerland (Jörg, 2009), in Ireland in Woodfield bog (Doyle &amp; Duckett, 1985), in Norway on Tromøy Island near</li> </ul> |

| Question   | Rating + uncertainty                   | Explanatory text of rating and uncertainty  |
|--|--|---|
|  |  | <p>Arendal (Åsen, 2002), and in the UK where it is considered to have been planted in the majority of the recorded sites (Newman, pers. comm., 2009), in the Netherlands, the plant was a relict of a nursery site (Rotteveel, 2007), in Belgium it has been planted along a watercourse in an arboretum (E Branquart, pers. comm., 2009).</p> <ul style="list-style-type: none"> <li>- throwing away material containing seeds, rhizome or young seedlings of plant: it is assumed that in Western Ruhrgebiet, the plants were transferred through inappropriate disposal of garden waste (Fuchs et al., 2003).</li> </ul> <p>When planted in suitable natural habitats, or when seeds and rhizomes of the plant are discarded into suitable natural habitats, the species is likely to establish. It has been observed in e.g. Germany, Belgium, and Switzerland. Nevertheless, according to the Habitats Directive (EU 92/43/EEC) and national legislation (e.g. in Switzerland, the Nature and Cultural Heritage Protection Act (NHG)) introduction of exotic species into natural habitats is prohibited.</p> <p>When planted near streams, it is likely that the species will escape to natural habitats.</p> |
| <p><b>Conclusion on the probability of entry. Risks presented by different pathways.</b></p>                         | <p>Very likely<br/>Low uncertainty</p> | <p>The plant has already entered the EPPO region, and is produced and traded within the European Union and the EPPO region, and imports are reported as meristem tissue from Indonesia to the Netherlands, and seeds and plants are sold on the Internet.</p>   |
| <p><b>1.16. Estimate the number of host plant species or suitable habitats in the PRA area (see question 6).</b></p> | <p>Few<br/>low uncertainty:</p>        | <p>It has been found in wetlands including raised bogs (Doyle &amp; Duckett, 1985) swamps, riverbanks, lakesides, wet woodlands (Alberternst &amp; Nawrath, 2002), and pond margins and in permanently wet soils in alluvial forests, moorlands and wet meadows (Vanderhoeven <i>et al.</i>, 2007). All these habitats are present in the PRA area.</p>   |
| <p><b>1.17. How widespread are the host plants or suitable habitats in the PRA area? (specify)</b></p>               | <p>Moderate<br/>Low</p>                | <p>see CORINE LAND COVER (2009). (Appendix 1)<br/>Corine Land Cover reports in Europe (<a href="http://dataservice.eea.europa.eu/dataservice/">http://dataservice.eea.europa.eu/dataservice/</a>):</p>  |

| Question   | Rating + uncertainty                      | Explanatory text of rating and uncertainty   |
|--|---|--|
|  | uncertainty                               | <ul style="list-style-type: none"> <li>- Inland marshes: 1,082,068 ha</li> <li>- Peat bogs: 2,104,401 ha</li> <li>- Water courses: 807,977 ha</li> <li>- Water bodies: 3,073,442 ha.</li> </ul> <p><i>L. americanus</i> can only grow in damp margins of water courses and water bodies, and the surface areas quoted for these habitats have to be considered with care. Additionally, the species is also limited to acidic and humic-rich soils, further reducing its area of potential establishment.</p>  |
| <p><b>1.18. If an alternate host or another species is needed to complete the life cycle or for a critical stage of the life cycle such as transmission (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers), how likely is the pest to come in contact with such species?</b></p> | <p>Very likely</p> <p>Low uncertainty</p> | <p><i>L. americanus</i> is self-compatible and is considered to be capable of self-pollination due to partial temporal overlap between male and female function in the inflorescences (Pellmyr &amp; Patt, 1986).</p> <p>In its native range in North America, <i>L. americanus</i> is pollinated by adults of <i>Pelecomalius testaceum</i> (Coleoptera: Staphylinidae), which feed on the pollen and use the inflorescences as a mating site (FNA, 2009; Pellmyr &amp; Patt, 1986). This species is not present in Europe, nevertheless, in France, Dipteran species have been observed on the species, and are assumed to be the species pollinating arums (Lebreton, 2007). These species are common in the EPPO region, and <i>L. americanus</i> is known to reproduce almost exclusively by seed production.</p> <p>The plant can also reproduce vegetatively.</p> <p>Spread of seeds can occur via water, no other species is needed. Although spread may also be ensured by birds and other animals, it only occurs occasionally in its native range (Willson and Hennon, 1997), and accurate information for the PRA area is missing.</p> |

| Question   | Rating + uncertainty                               | Explanatory text of rating and uncertainty  |
|--|--|---|
| <p><b>1.19. How similar are the climatic conditions that would affect pest establishment, in the PRA area and in the current area of distribution?</b></p> | <p>Completely similar<br/><br/>low uncertainty</p> | <p><i>L. americanus</i> has already established in at least 11 EPPO member countries (Belgium, Denmark, France, Finland, Germany, Finland, Ireland, the Netherlands, Sweden, Switzerland, United Kingdom).</p> <p><i>L. americanus</i> is typically associated with climates Cf, Dfb and Dfc in Köppen's classification, i.e. cool to hot summer, very cold to cool winter, wet year round. <i>L. americanus</i> is hardy at least to zone 7 (−15°C), and possibly colder. It is associated with the vegetation zones: temperate deciduous forests, mixed conifer forests, taiga forests, forest tundra (EPPO 2006).</p> <p>A climatic prediction with the software CLIMEX has been performed and highlights that Northern and Western Europe are the most at risk. The Mediterranean area is not considered at risk as it is assumed to be too warm and too dry during summer (see Appendix 1).</p> <p>Countries where the species could establish include: Austria, Azerbaijan, Belarus, Belgium, Bosnia &amp; Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Republic of Macedonia, Romania, Russia, Serbia, Slovenia, Spain (North), Sweden, Switzerland, Turkey (east coast of the Black Sea), Ukraine.</p> <p>Areas particularly at risk are areas having an Atlantic influence (the UK, Ireland, Northern coast of Spain, Bretagne in France, the Netherlands, Denmark, Norway) and mountainous areas (the Massif central in France, the Alps, the Pyrenees, the Carpatian Mountains, Bolsoj Kavkaz in Georgia, Ural Mountains in Russia).</p> |
| <p><b>1.20. How similar are other abiotic factors that would affect pest establishment, in the PRA area and in the current area of distribution?</b></p>   | <p>Completely similar<br/><br/>Low uncertainty</p> | <p>In its native range, the typical soil associated with this species in Alaska is Histosol (D'Amore &amp; Lynn, 2002). In Southeast Alaska, North-west Canada, America and California the species is an obligate wetland species (Reed, 1988; Fish and Wildlife Service, 1996). It is found in calcareous fens in Southeast Alaska, these fens can be classified floristically as the Sitka sedge-forb community type. In these calcareous fens, the pH values of 6.7 to 7.4 and calcium concentrations of 41.8 to 51.4 mg/L are recorded (McClellan <i>et al.</i>, 2003). Calcareous fens are a very unusual habitat for this area, and</p>   |

| Question   | Rating + uncertainty                      | Explanatory text of rating and uncertainty  |
|--|---|---|
|  |   | <p>although <i>L. americanus</i> was found at two locations, it is likely that the conditions reported in this paper are not the ideal habitat for this species, and it is assumed that the species grows best in acidic saturated soils.</p> <p>The principal environmental factor determining presence of <i>L. americanus</i> is the absence of soil drainage in southeastern Alaskan forests (Hanley &amp; Brady, 1996). It can also tolerate fluctuating water levels (Washington Department of Education Datasheet).</p> <p>According to Klinkenberg (2008), it is found in British Columbia at elevations between 358 and 1740 m.</p> <p>In the Eppo region, it is found in the same conditions as in its native range. The EWG concluded from field experience that <i>L. americanus</i> can grow in acid or neutral permanently wet soils and grows better in deep humus rich soils. It has been observed in the Taunus (Germany) to grow in flowing or standing waters of up to 30 cm depth (Alberternst, pers. comm., 2009). It usually occurs in semi-shaded situations, tolerates shade and also grows well in full light. The EWG concluded that the factor determining the presence of the species is permanently wet acidic soils (see map in Appendix 1).</p> <p>In Europe, Fuchs (2008) determined the following abiotic factors for <i>L. americanus</i>:</p> <ul style="list-style-type: none"> <li>- for light (4); semi-shade plant,</li> <li>- soil moisture (9); plant often on waterlogged, badly aerated soils</li> <li>- for soil nitrogen (5); intermediate fertility.</li> </ul> <p>Note : numbers between brackets refers to Ellenberg ecological scores (Ellenberg <i>et al.</i>, 1992).</p> |
| <p><b>1.21. If protected cultivation is important in the PRA area, how often has the pest been recorded on crops in protected cultivation elsewhere?</b></p> | <p>Never</p> <p>Low uncertainty</p>       | <p><i>L. americanus</i> has never been found in protected cultivation.</p>  |
| <p><b>1.22. How likely is it that establishment will occur despite competition from existing species in the PRA area?</b></p>                                | <p>Very likely</p> <p>low uncertainty</p> | <p>The plant already established in at least 11 countries. The EWG concluded that in its preferred habitat in under storey forest, there are no serious competitors. Additionally, <i>L. americanus</i> has a competitive advantage because leaf development starts earlier in the season and the plants are generally taller than native under storey plants, and out compete them.</p>  |



| Question   | Rating + uncertainty                     | Explanatory text of rating and uncertainty  |
|--|--|---|
|  |  |   |
| <b>1.23. How likely is it that establishment will occur despite natural enemies already present in the PRA area?</b>                       | Very likely<br><br>Low uncertainty       | In its native range, this species is eaten by black tailed deer ( <i>Odocoileus hemionus sitkensis</i> ) (Gillingham <i>et al.</i> , 1997 and 2001) and by Grizzly bear ( <i>Ursus arctos</i> ) (Gyug, 2004). These species are not present in the PRA area. The fruits and seeds have not been reported as being eaten by animals in the EPPO region (Alberternst, pers. comm., 2006)). Several species of slugs (Succineidae) and snails eating the leaves of <i>L. americanus</i> have been observed in the Haute-Vienne station in France (Lebreton, 2007), but this did not prevent the plant from establishing. |
| <b>1.24. To what extent is the managed environment in the PRA area favourable for establishment?</b>                                       | Favourable<br><br>Low uncertainty        | The species is planted along watercourses and in ponds and artificial lakes. These managed environments are favorable for the establishment of <i>L. americanus</i> . Maintenance work in infested areas may spread seeds of the plant (e.g. movement of soil, cleaning of ponds, etc).<br><br>In natural areas (swamps, peat bogs, etc.), there are very few management activities.  |
| <b>1.25. How likely is it that existing pest management practice will fail to prevent establishment of the pest?</b>                       | Likely<br><br>Low uncertainty            | In natural habitats, there are few existing pest management practices (see Q. 1.24). In managed environment (watercourses banks, artificial lakes), the species may be favoured if it has been planted, and management practice will not target <i>L. americanus</i> .  |
| <b>1.26. Based on its biological characteristics, how likely is it that the pest could survive eradication programmes in the PRA area?</b> | Moderately likely<br><br>low uncertainty | When infested areas are still restricted, eradication is feasible. Eradications of small populations undertaken in the Netherlands, Switzerland, Germany prove successful.<br><br>Due to the sensitive ecosystems where <i>Lysichiton americanus</i> occurs (wetlands), mechanical control are usually preferred. Chemical control measures are only appropriate in some areas of the EPPO region.  |

| Question | Rating + uncertainty | Explanatory text of rating and uncertainty   |
|----------|----------------------|--|
|          |                      | <p>Since only older plants (3 years or older) of <i>L. americanus</i> are producing seeds (E. Jörg, pers. comm., 2009), controlling the plants in an early stage of infestation results in a rapid decline of plants, as the example from Switzerland shows.</p> <p><b>Germany</b> has developed programmes to eradicate <i>L. americanus</i> (Convention on the Conservation of European Wildlife and Natural Habitats, 2007). In the Taunus, the population is quite large and there is a big seed bank (30.000 to 40.000 individuals had been removed since 2001).</p> <p>In 2001 different mechanical measures to control <i>Lysichiton</i> in the Taunus were tested: mowing, cutting through the vegetation point, digging up the plants. Due to the high regeneration potential of the plant, digging up the whole plant came out to be the only suitable method to remove it.</p> <p>Since 2004 in the Taunus all stands of <i>Lysichiton americanus</i> were dug up twice a year until now. At the end of 2008 big plants (bigger than 80 cm leaf length) were not found any more. Nearly 95 % of plants between 40-80 cm were removed in comparison to the start of the measures and in 2008, at least 3773 young plants were removed in the whole Taunus. The results show, that it is very laborious to remove <i>Lysichiton</i> on stands which are suitable for the plant once it had established and produced a seed bank. The species builds up a seed bank – at least for 8 years - maybe longer.</p> <p>The <i>Lysichiton</i> stand in the Harz was also successfully removed in 2005 to prevent further spreading. The stand in Western Ruhrgebiet is monitored and was not removed to study the behaviour of the plant. (Fuchs et al., 2003; B. Alberternst, pers. comm., 2009).</p> <p><b>The UK</b></p> <p>Attempts at eradication have only started in 2005 in England (Sussex) and Scotland (in Loch Lomond and the Trossachs, Scotland's first National Park, in the southern Highlands, RHS, 2006), when recognition of rapid spread along watercourses was perceived as a problem. Attempts at control using glyphosate were unsuccessful, with only limited stunting of the plants. Application of 2,4-D amine at 9.0 L/ha in May controlled <i>L. americanus</i> at a private garden in Sussex and also at Sheffield Park Garden,</p> |

| Question | Rating + uncertainty | Explanatory text of rating and uncertainty  |
|----------|----------------------|---|
|          |                      | <p>a National Trust Property in the same area.<br/>As the plant is considered a desirable ornamental species, control actions are not undertaken widely in the UK in private gardens, only where escape or deliberate planting in the wild has occurred is any action likely to be taken.</p> <p>Control costs: application of herbicides is relatively cheap, and eradication costs could be as little as €600 per hectare in the UK.<br/>Eradication by digging out has not been attempted in the UK (Newman, pers. comm., 2009).</p> <p><b>The Netherlands</b><br/>Eradication was undertaken with volunteers in December 2005 in one site by digging up the plants, when the level of water was low enough to allow access. Removed plants were destroyed by deep burial in dry ground. The operation was continued on June 2006. Since the plant forms a seed-bank, the site will be inspected every year and eradication will be considered successful only if no regrowth is observed for five years. In 2008, 2 plants of over 1 year old, and dozens of new seedlings were found and subsequently removed (Internal report Rotteveel, 2008). Manual removal by volunteers proved to be efficient for a small outbreak of a slow-growing plant, but was difficult to organize in practice (Rotteveel, 2007).</p> <p><b>Switzerland</b><br/>When <i>L. americanus</i> was discovered in Switzerland in 2003, two people spent 4 hours digging out the 100 plants. In the following year, there were only about 20 plants to dig out and in 2005 and 2006 just a few young individuals were found. In 2007 and 2008 no more plants had germinated. In the future, it is planned to monitor the site every second year for regrowth (S. Buholzer, pers. comm., 2009). Total costs to date have been around €1000, declining from €500 in 2003, to just monitoring costs from 2008 onwards (S Buholzer, pers. comm., 2009).</p> |

| Question   | Rating + uncertainty                              | Explanatory text of rating and uncertainty  |
|--|---|---|
| <p><b>1.27. How likely is the reproductive strategy of the pest and the duration of its life cycle to aid establishment?</b></p> | <p>Moderately likely<br/><br/>low uncertainty</p> | <p>Plants do not flower every year in their native range. Plants at shady sites and small plants are more likely to fail to flower (Willson &amp; Hennon, 1997). In the PRA area only plants of 3 years or older produce seeds (E. Jörg, pers. comm., 2009; FloraWeb (2006).)),</p> <p><i>L. americanus</i> produces many seeds (each spadix has between 100-300 berries FNA, 1993; 300-650 seeds per spadix in Germany Alberternst &amp; Nawrath 2002), and a large seed bank can build up in the soil, remaining viable for at least 8 years (Alberternst pers. comm. 2009). The EWG concluded that <i>L. americanus</i> has a competitive advantage because leaf development starts earlier in the season and plants are taller than native understorey plants, and out compete them.</p> <p>Vegetative reproduction by fragmentation of stems/ rhizomes is possible and has occurred in the Taunus after fragmentation during the control measures (B Alberternst, pers. comm., 2009) (see pictures in Appendix 4).</p> <p>Nevertheless, a survey performed in Switzerland in nurseries highlighted that the plant is difficult to grow. In average garden soil, it often survives for less than two or three years (personal comment from different sellers) (S. Buholzer, pers. comm., 2009). In the Netherlands, only a few nurseries have mastered the skill of propagating <i>Lysichiton</i> to make it a profitable business (J van Valkenburg, pers. comm., 2009).</p> |

| Question   | Rating + uncertainty                | Explanatory text of rating and uncertainty   |
|--|-------------------------------------|--|
| <b>1.28 How likely are relatively small populations to become established?</b>   | Likely<br><br>Low uncertainty       | The plant is already established in the EPPO region. The EWG considered that a considerable number of the populations are derived from meristem culture, and those raised from seeds originate from a limited number of seed supplies held by botanic gardens and other specialists. The established species are therefore considered to come from small populations.                    |
| <b>1.29. How adaptable is the pest?</b>  | Low<br><br>Low uncertainty          | There is no evidence on the adaptability of the plant. <i>L. americanus</i> only colonizes a limited number of habitats, and is restricted to permanently wet soils. In its native range, it is restricted to the North Western Coast of North America. In the EPPO region, the plant has not been found in eco-climatic conditions different from the ones present in its native range. |
| <b>1.30. How often has the pest been introduced into new areas outside its original area of distribution? (specify the instances, if possible)</b> | Occasionally<br><br>Low uncertainty | The plant originates from the coastal zone of north west North America and has only been introduced in Europe. Within Europe, it is present in 11 countries  |

| Question   | Rating + uncertainty                                 | Explanatory text of rating and uncertainty  |
|--|--|---|
| <b>1.31. If establishment of the pest is very unlikely, how likely are transient populations to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment) ?</b> |  | Establishment of the plant has already occurred in at least 11 countries of the EPPO region.  |
| <b>Conclusion on the probability of establishment</b>  | Very high<br><br>Low uncertainty                     | The pest has already established in at least 11 countries of the EPPO region, the probability of establishment is therefore very high in suitable conditions. According to the climatic prediction, areas particularly at risk are areas having an Atlantic influence (the UK, Ireland, Northern coast of Spain, Bretagne in France, the Netherlands, Denmark, Norway) and mountainous areas (the Massif central in France, the Alps, the Pyrenees, the Carpatian Mountains, Bolsoj Kavkaz in Georgia, Ural Mountains in Russia).   |
| <b>1.32. How likely is the pest to spread rapidly in the PRA area by natural means?</b>  | Unlikely to moderately likely<br><br>Low uncertainty | <p>The plant is perennial and grows at a slow rate but can get very old (up to 75 years) (Rosendahl, 1911). With maturity of the seeds, the spadix becomes fragile, disconnects from the flower stalk and falls to the ground close to the mother plant. Only plants of 3 years or older produce seeds. Most seeds fall to the ground and therefore germinate directly next to the mother plant.</p> <p>In its native range, local seed dispersal may be achieved in part by means of water moving from the ground surface. Occasionally seeds may be carried greater distances by animals, e.g. in mud adhering to feet Chestnut-Backed chickadees (<i>Parus rufescens</i>) and Steller's jays (<i>Cyanistta stelleri</i>) often harvest the seeds from the spadix and may occasionally disperse a few seeds (Willson &amp; Hennon, 1997).</p> <p>In the EPPO region, seeds have been observed to be carried downstream along waterways (e.g. in Denmark, in France, in the UK, in Germany). Although birds are involved in the spread of the plant in its native area, such phenomenon has not been observed in the EPPO region, but close relatives of the propagating birds of North America also occur (tits, crows and jays). (Klingenstein and Alberternst, 2006). The EWG considered that it is quite probable that similar processes occur in the EPPO</p> |

| Question  | Rating + uncertainty                            | Explanatory text of rating and uncertainty  |
|---|---|---|
|   |   | <p>region.<br/>Spread by fragmentation of rhizomes is unlikely to occur by natural means.</p> <p><b>In France, the species is recorded in 2 sites (see question 8).</b><br/>In the massif of the mount Pilat, there are between 15 and 20 individuals which have spread along the river Furan around 2.7 km downstream from the private garden where it is supposed to have escaped from (Conservatoire Botanique national du Massif central, pers. comm., 2009). (J.-M. Tison, pers. comm., 2009). Over a period of about 10 years the species has only spread 3 km.<br/>In the second location in Haute Vienne an increasing number of individuals have been recorded: 4 in 2005, 12 in 2006 and 2007 and 32 in 2008, of which the majority were seedlings close to the parent plant (Lebreton, pers. comm., 2009). The spatial spread is very slow.</p> <p><b>In Germany</b><br/>In a <i>Lysichiton</i> stand in Western Ruhrgebiet, which was found in 1980, plants have persisted but have not spread as in the Taunus (Fuchs, et al. 2003; Alberternst, pers. Comm. 2009).</p> <p>In the UK, it is considered that the spread by natural means is not rapid (Newman, pers. comm., 2009), but may occur occasionally when adequate stream flows and seed maturity coincide. Natural dispersal and spread is considered to be stochastic in the UK.<br/>The EWG considered that the spread by natural means is unlikely to moderately likely.</p> |
| <p><b>1.33. How likely is the pest to spread rapidly in the PRA area by human assistance?</b></p> | <p>Moderately likely</p> <p>Low uncertainty</p> | <p>The plant does not seem to move easily to new waterbodies and water catchments without human assistance.<br/>Long-distance spread can most probably occur only with human assistance, i.e. deliberate planting in the wild (e.g. in Germany), planting in a garden adjacent to a vulnerable location, or through disposal of garden wastes in unintended habitats (EPPO, 2006).<br/>See Q. 1.1 for spread from intended to unintended habitats, as well as for direct planting in natural areas.</p>   |

| Question | Rating + uncertainty | Explanatory text of rating and uncertainty   |
|----------|----------------------|--|
|          |                      | <p>The EWG considered that spread by fragmentation of rhizomes through machines and vehicles or other human activities is unlikely to happen due to the depth of the rhizomes of the plant, and the few management measures in the habitats where it occurs (see Q. 1.24 &amp; 1.25).</p> <p>The species is produced and traded within the EPPO region. Hobby gardeners could exchange and spread the plant, but it is not considered an important pathway. It is sold in many European countries, including southern countries e.g. Italy (EPPO, 2006). The plant is grown in botanical gardens in Europe. In 1993, <i>Lysichiton americanus</i> received an “Award of Garden Merit” from the Royal Horticultural Society Floral Committee (GB) in the UK. It is not a mass selling ornamental (see q. 1.1), but is readily available from garden catalogues and internet sites (e.g. available from 38 suppliers in Great Britain according RHS (2009). According to the PPP-Index in 2009 (ppp-index, 2009), <i>Lysichiton</i> spp. are available from 136 growers in EU countries.</p> <p>Information gathered on the trade of <i>L. americanus</i> from individual countries is presented below:</p> <p><b>Switzerland</b></p> <p>To understand the scale of supply in Switzerland, a survey was conducted of 12 nurseries and garden centres identified by an internet search. They were asked how many plants of <i>L. americanus</i> they sell in a year, whether they propagated <i>L. americanus</i> themselves or bought it from nurseries in Switzerland or imported it from abroad. The survey showed that <i>L. americanus</i> is sold in small numbers. Six nurseries indicated they sold less than ten plants a year. Another three sold between 10 and 40 plants a year and one sold 40 to 50 plants. The reasons may be that the species is rather difficult to grow and expensive (€15). Of the 12 nurseries interviewed, eight still sell <i>L. americanus</i>. Two nurseries stopped selling it recently and two never sold this species although they have it still on their catalogue. Only three of them propagate the species themselves (one of them just a low number of individuals), three import the plants directly from the Netherlands (one of which is a reseller of about 40 to 50 plants a year). The rest are bought from producers in Switzerland.</p> |



| Question | Rating + uncertainty | Explanatory text of rating and uncertainty  |
|----------|----------------------|---|
|          |                      | <p>The total sale of the plant in Switzerland is estimated to be between 5000 to 10.000 euros a year (S Buholzer, pers. comm., 2009).</p> <p><b>Germany</b><br/> The umbrella organisation for horticulture states that the species only has minor importance for the horticultural industry in Germany (Zentralverband Gartenbau e.V., 2008).<br/> The price for one plant is relatively high (4,60,- €, e.g. Internet seller: <a href="https://bluetenblatt-de.prossl.de/shop/?pflanze=Lysichiton&amp;warengr=&amp;buchstabe=L">https://bluetenblatt-de.prossl.de/shop/?pflanze=Lysichiton&amp;warengr=&amp;buchstabe=L</a>) (B Alberternt, pers. comm., 2009).</p> <p>Of 35 nurseries contacted, 21 provided information (G Schrader, pers. comm., 2009):</p> <ul style="list-style-type: none"> <li>- 4 nurseries produce the plants themselves</li> <li>- 1 nursery both produces plants but also buys some from German producers</li> <li>- 11 only buy plants from German nurseries (mostly from two of the 4 nurseries mentioned above)</li> <li>- 2 buy plants from the Netherlands</li> <li>- 1 buys plants from Belgium</li> <li>- 2 do not sell <i>L. americanus</i> (anymore).</li> <li>- 4 report that this article is not very important (one mentioned around 100 plants being sold per year).</li> </ul> <p>Sales at garden centres are unknown.</p> <p><b>The Netherlands</b><br/> The production is estimated to be 20.000-40.000 for the Dutch market and a comparable volume for export. Plants on sale are 1-2 years old, and it takes a few more years for these to start producing flowers. Because of the extensive fleshy root system which is prone to damage and resulting in adverse effects on further plant development, plants of flowering size and age are too bulky and too expensive for trade purposes. The volume in trade for <i>L. camtschatcensis</i> is comparable to <i>L. americanus</i> (J van Valkenburg, pers. comm., 2009).</p> |

| Question  | Rating + uncertainty            | Explanatory text of rating and uncertainty  |
|---|---------------------------------|---|
|   |                                 | <p><b>Great Britain</b><br/>In Great Britain, 4 major aquatic nurseries supply both <i>L. americanus</i> and <i>L. camtchatcensis</i>. These four nurseries supply over 90% of the aquatic retail trade in the UK. The number of retailers that stock the species is unknown, but it could be estimated at least 50% (Jonathan Newman, per. comm., 2009). The sales volume is unknown in the UK. Both species can be purchased on internet, the price being £7.00 for <i>L. americanus</i> and £7.95 for <i>L. camtchatcensis</i> (M.A. Duenas pers. comm., 2009). There are 38 smaller specialist nurseries listed as suppliers in the UK in RHS plant finder (RHS, 2009)</p> <p><b>France</b><br/>In France, <i>L. americanus</i> is available in at least 10 nurseries that list the plant on their online catalogue (<a href="http://www.truffaut.com/conseils/encyclopedie-plantes/fiche-plante_plantes-bassin_arum-bananier-americanus/type_plante/7/id_plante/11733.html">http://www.truffaut.com/conseils/encyclopedie-plantes/fiche-plante_plantes-bassin_arum-bananier-americanus/type_plante/7/id_plante/11733.html</a>) (see Appendix 5).</p> |
| <b>1.34. Based on biological characteristics, how likely is it that the pest will not be contained within the PRA area?</b> | Unlikely<br><br>Low uncertainty | If measures are applied early and continuously (e.g. in Switzerland), containment is likely, as the species has a low natural spreading rate to new sites (see Q. 1.32 & 1.33). When populations are bigger (e.g. in Germany), this requires central organization, funding and perseverance. See also questions 1.26 and 1.27.  |
| <b>Conclusion on the probability of spread</b>  |                                 | <p>The factors that govern spread of this species have increased since the last assessment in 2005. These include:</p> <ul style="list-style-type: none"> <li>- much higher number of plants on sale within the EPPO region,</li> <li>- increased internet availability</li> </ul> <p>Even if spread may occur, it will be restricted to acidic wetlands with permanently wet soils. The probability of spread by natural means from introductions is considered to be medium, while natural spread to new sites is considered to be low.</p> <p>The overall probability of spread is medium, uncertainty is low.</p>   |

| Question   | Rating + uncertainty | Explanatory text of rating and uncertainty  |
|--|----------------------|---|
|  |                      | <p>The ISEA protocol aiming at drafting alert lists in Belgium ranked the dispersal capacity (both natural and human assisted) of this plant as medium (<a href="http://ias.biodiversity.be/ias/species/show/13">http://ias.biodiversity.be/ias/species/show/13</a>).</p>   |
| <p><b>Conclusion on the probability of introduction and spread</b><br/> <b>The overall probability of introduction and spread should be described. The probability of introduction and spread may be expressed by comparison with PRAs on other pests.</b></p> |                      | <p>Concerning entry, it appears that production of the plant mainly occurs within the EPPO region.</p> <p>Where planted under Northern and Western climates and in wetland habitats, <i>L. americanus</i> is able to establish by producing seeds. Seeds usually fall near the parent plants, but can also be spread through water or human activities. The spread through animals cannot be quantified and is not considered to be a significant pathway for spread.</p> <p>The overall probability of introduction and spread to areas of the EPPO region where it is currently not present is moderately high to high. Nevertheless, if detected at an early stage, the species can be eradicated.</p> |

| Question   | Rating + uncertainty | Explanatory text of rating and uncertainty  |
|--|----------------------|---|
| <p><b>Conclusion regarding endangered areas</b><br/> <b>1.35. Based on the answers to questions 1.16 to 1.34 identify the part of the PRA area where presence of host plants or suitable habitats and ecological factors favour the establishment and spread of the pest to define the endangered area.</b></p>  |                      | <p>As <i>Lysichiton americanus</i> occurs in North America from Alaska to California and has established in at least 11 European Countries (Belgium, France, Denmark, Finland, Norway, Sweden, Switzerland, Ireland, Great Britain, Germany, The Netherlands) it is assumed that swamp woods and other inland wetlands in northern and western EPP region are at risk. The Mediterranean area is not considered at risk as it is assumed to be too warm and too dry during summer (see Appendix 3). In the Mount Pilat where continental climate with some Mediterranean influences prevails, the negative dynamic of the plant is believed to be a consequence of too hot temperatures.</p> <p>Countries where the species could establish include: Austria, Azerbaijan, Belarus, Belgium, Bosnia &amp; Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Republic of Macedonia, Romania, Russia, Serbia, Slovenia, Spain (North), Sweden, Switzerland, Turkey (east coast of the Black Sea), Ukraine.</p> <p>Areas particularly at risk being are areas having an Atlantic influence (the UK, Ireland, Northern coast of Spain, Bretagne in France, the Netherlands, Denmark, Norway), and mountainous areas (the Massif central in France, the Alpes, the Pyrenees, the Carpatian Mountains, Bolsoj Kavkaz in Georgia, Ural Mountains in Russia).</p> |
| <p><b>2. In any case, providing replies for all hosts (or all habitats) and all situations may be laborious, and it is desirable to focus the assessment as much as possible. The study of a single worst-case may be sufficient. Alternatively, it may be appropriate to consider all hosts/habitats together in answering the questions once. Only in certain circumstances will it be necessary to answer the questions separately for specific hosts/habitats.</b></p> |                      |   |

| Question   | Rating + uncertainty                             | Explanatory text of rating and uncertainty   |
|--|--|--|
| <p><b>2.1. How great a negative effect does the pest have on crop yield and/or quality to cultivated plants or on control costs within its current area of distribution?</b></p> | <p><b>Minimal</b><br/><b>Low uncertainty</b></p> | <p>No presence in crops or cultivated lands (see question 1.21).</p> <p>The costs of control measures are not known for all countries, but they differ significantly. In Switzerland, only one hundred plants were dug out in the first and controlled in the second season and cost around 1000 euros, while in the Taunus several thousand plants in many localities were dug out by volunteers and forest workers. (Klingenstein and Alberternst, 2006). The total costs of removing <i>Lysichiton americanus</i> from the Taunus since 2001 up to 2008 including research work on the species (e.g. mapping, ecological studies, documentation, monitoring) were estimated to 53,000 € (B Alberternst, pers. comm., 2009)<br/>The cost of chemical control is 600 euros/ha/site visit in the UK (Newman, pers. comm., 2009).</p> |
| <p><b>2.2. How great a negative effect is the pest likely to have on crop yield and/or quality in the PRA area without any control measures?</b></p>                             | <p><b>Minimal</b><br/><b>Low uncertainty</b></p> | <p>No presence in crops or cultivated lands (see question 1.21).</p>   |

| Question  | Rating + uncertainty                                      | Explanatory text of rating and uncertainty   |
|---|---|--|
| <b>2.3. How easily can the pest be controlled in the PRA area without phytosanitary measures?</b>                                   | <b>With much difficulty</b><br><br><b>Low uncertainty</b> | <i>L. americanus</i> cannot be controlled without phytosanitary measures in areas where management is necessary to eradicate the species or to prevent the spread. Due to the sensitive ecosystems where <i>L. americanus</i> occurs, chemical methods are only appropriate in some situations, while mechanical control measures can be used. Eradication actions at early stages undertaken by countries have given good results (see question 1.26) and may be sufficient.  |
| <b>2.4. How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area?</b> | <b>Low to moderate</b><br><br><b>Low uncertainty</b>      | Control costs include:<br><ul style="list-style-type: none"> <li>- monitoring of the species in habitats where it could occur and spread.</li> <li>- Treatment: mechanical control (digging out) is the most feasible option.</li> </ul>   |
| <b>2.5. How great a reduction in consumer demand is the pest likely to cause in the PRA area?</b>                                   |   | Not relevant   |
| <b>2.6. How important is environmental damage caused by the pest within its current area of distribution?</b>                       | Minor to Moderate<br><br><b>Low uncertainty</b>           | In the native range, no environmental impacts are reported.<br><br>In the EPPO region, <i>Lysichiton americanus</i> is able to establish in particularly vulnerable habitats such as woods and bog woodlands which are nature conservation areas listed under EU Directive 92/43 (EU, 1992) (EPPO, 2006). After some years its huge leaves build a dense layer excluding light from native species which usually are not adapted to extreme darkness because native swamp woods are more porous. There is locally high damage in the Taunus in Germany. In other countries, impacts have not been documented.<br><br>In the Taunus area of Germany, adverse environmental impacts such as species displacement and local extinctions have been reported and attributed to the presence of <i>L. americanus</i> (König & Nawrath, 1992), due to the formation of dense layers of vegetation which exclude light, and thus affect biodiversity in ecologically sensitive wetland habitats. It can displace, and cause local extinction of rare species of mosses (like |

| Question   | Rating + uncertainty                            | Explanatory text of rating and uncertainty  |
|--|---|---|
|  |   | <p>different <i>Sphagnum</i> species) and vascular plants (<i>Carex echinata</i>, <i>Viola palustris</i>, and orchids) (König &amp; Nawrath, 1992, Alberternst &amp; Nawrath, 2002), some of them included in the national red lists. In the Taunus, studies have shown a reduction in species number of more than 50% in dense stands (B Alberternst, pers. comm., 2009). See Appendix 4.</p> <p>Although the species is present in 6 sites in Germany, the Taunus is the only site where the species is known to be invasive (B. Alberternst, pers. comm., 2009).</p> <p>In Switzerland in the bog of Meienmoos no negative impact are reported, because of the early eradication of all plants.</p> <p>In France, no impacts are reported from the sites where the plant is known in the Mount Pilat (J.-M. Tison, pers. comm., 2009). This may be due to the lack of compatibility with the climatic optimum of the species in that area (see <b>Conclusion regarding endangered areas</b>) that may reduce the competitiveness of plants. In Haute-Vienne, <i>L. americanus</i> has not yet induced changes in vegetation (A. Lebreton, pers. comm., 2009) but this seems understandable since there is currently only 32 individuals most of which are seedlings.</p> <p>In the UK, although <i>L. americanus</i> often occurs in quite dense stands, there are no survey data to assess changes in native vegetation. This is due to the acceptance of <i>L. americanus</i> as a garden plant in the UK (Newman, pers. comm., 2009).</p> |
| <p><b>2.7. How important is the environmental damage likely to be in the PRA area (see note for question 2.6)?</b></p> | <p>Minor to Moderate</p> <p>Low uncertainty</p> | <p>The deleterious effects on biodiversity described above could also occur in other countries.</p>   |

| Question   | Rating + uncertainty           | Explanatory text of rating and uncertainty  |
|--|--------------------------------|---|
| <b>2.8. How important is social damage caused by the pest within its current area of distribution?</b>   | Minimal<br><br>Low uncertainty | Although the plant is moderately harmful if eaten (containing calcium oxalate raphides), this does not present a great risk to animals or man in practice. Social damage is considered minimal (EFSA, 2007). In its native range the roots have even some value as medicine (Thomas & Schumann, 1993). The Flora of North America states (FNA, 1993, <a href="http://www.efloras.org">http://www.efloras.org</a> ): “Plants of this species were used as food, as medicine, and also in the material culture of Native Americans of north-western North America (S. A. Thompson 1995)”. |
| <b>2.9. How important is the social damage likely to be in the PRA area?</b>   | Minimal<br><br>Low uncertainty | See question above.   |
| <b>2.10. How likely is the presence of the pest in the PRA area to cause losses in export markets?</b>   |                                | Not relevant.   |
| <b>As noted in the introduction to section 2, the evaluation of the following questions may not be necessary if the responses to question 2.2 is "major" or "massive" and the answer to 2.3 is "with much difficulty" or "impossible" or any of the responses to questions 2.4, 2.5, 2.7, 2.9 and 2.10 is “major” or “massive” or “very likely” or “certain”. You may go directly to point 2.16 unless a detailed study of impacts is required or the answers given to these questions have a high level of uncertainty.</b> |                                |   |



| Question   | Rating + uncertainty                 | Explanatory text of rating and uncertainty   |
|--|--------------------------------------|--|
| <b>2.11. How likely is it that natural enemies, already present in the PRA area, will not reduce populations of the pest below the economic threshold?</b>                   | Very likely<br>Low uncertainty       | See question 1.23.<br>The consumption of the leaves of <i>L. americanus</i> by slugs observed in France is quite frequent but does not cause sufficient damage to reduce the growth of the plant (A. Lebreton, pers. comm., 2009).   |
| <b>2.12. How likely are control measures to disrupt existing biological or integrated systems for control of other pests or to have negative effects on the environment?</b> | Moderately likely<br>Low uncertainty | Due to the sensitive ecosystems where <i>L. americanus</i> occurs, management measures are likely to have negative effects on the environment. Nevertheless, if not planted directly on protected sites (which is prohibited), the species establishment could be prevented if the species occurs near a natural area since it only has a low to medium capacity of spread, and is easy to identify.   |
| <b>2.13. How important would other costs resulting from introduction be?</b>   | Low to moderate<br>Low uncertainty   | Information and awareness.<br>Information to local populations would raise awareness on the topic of invasive alien plants and would ensure acceptance of management measures, and would prevent new plantations or escapes. Publicity may be provided by the horticultural industry or agencies, and this could be done through the implementation of a code of conduct on horticulture and invasive alien plants (Heywood & Brunel, 2009). See Conclusion of the assessment.<br><br>Monitoring<br>Invasive alien plants should be monitored within countries.<br><br>Knowledge and research<br>Knowledge about how long the seeds stay viable and whether the berries are transported by birds to assess the risk of spread and establishment might be undertaken. |
| <b>2.14. How likely is it that genetic traits can be carried to other species, modifying their genetic nature and making them more serious plant pests?</b>                  | unlikely<br>Low uncertainty          | The hybrid <i>Lysichiton americanus x camtschatcensis</i> is present in Belgium since 1997 (Verlove, 2006 in Daisie, 2009) and is thought to be sterile (Dr. Michael Kessler, who is the scientific manager of the botanical Garden of Zurich).<br>Johan van Valkenburg (per. comm., 2009) has noted that if both species are grown in close proximity crosses occur readily and the spathe colour of hybrid is pale yellow to lemon.  |

| Question   | Rating + uncertainty                     | Explanatory text of rating and uncertainty  |
|--|--|---|
|  |  |   |
| <p><b>2.15. How likely is the pest to cause a significant increase in the economic impact of other pests by acting as a vector or host for these pests?</b></p>  | <p>Unlikely<br/><br/>Low uncertainty</p> | <p>There are no records of <i>Lysichiton</i> acting as a vector or host of other pests.</p>   |
| <p><b>2.16. Referring back to the conclusion on endangered area (1.35), identify the parts of the PRA area where the pest can establish and which are economically most at risk.</b></p>   |  | <p>As mentioned previously, it is assumed that swamp woods and other inland wetlands in northern and western EPPO region are at risk. The Mediterranean area is not considered at risk as it is assumed to be too warm and too dry during summer.(see Appendix 1)</p> <p>Countries at risk are: Austria, Belarus, Belgium, Bosnia &amp; Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, France, Greece, Turkey, Hungary, Italy (northern part), Latvia, Lithuania, Luxembourg, Norway, Poland, Sweden, Switzerland, Ireland, Great Britain, Germany, The Netherlands, Portugal, Republic of Macedonia, Romania, Russia, Slovakia, Slovenia, Spain (North Atlantic coast), Ukraine.</p> <p>Areas particularly at risk being are areas having an Atlantic influence (the UK, Ireland, Northern coast of Spain, Bretagne in France, the Netherlands, Denmark, Norway), and mountainous areas (the Massif central in France, the Alpes, the Pyrenees, the Carpatian Mountains, Bolsoj Kavkaz in Georgia, Ural Mountains in Russia).</p> |
| <p><b>Degree of uncertainty</b><br/> <b>Estimation of the probability of introduction of a pest and of its economic consequences involves many uncertainties. In particular, this estimation is an extrapolation from the situation where the pest occurs to the hypothetical situation in the PRA area. It is important to document</b></p> | <p><b>Low</b></p>                        | <p>The areas of uncertainty identified are the following:</p> <ul style="list-style-type: none"> <li>- Details on environmental impacts in other countries than Germany</li> </ul> <p>Further researches to be undertaken:</p> <ul style="list-style-type: none"> <li>- investigations of the species behaviour in the wetland habitats in different locations (e.g. in Western Ruhrgebiet in Germany), in comparison with other areas (e.g. the Taunus)</li> </ul>   |

| Question  | Rating + uncertainty                    | Explanatory text of rating and uncertainty  |
|---|---|---|
| <p>the areas of uncertainty (including identifying and prioritizing of additional data to be collected and research to be conducted) and the degree of uncertainty in the assessment, and to indicate where expert judgement has been used. This is necessary for transparency and may also be useful for identifying and prioritizing research needs.</p> <p>It should be noted that the assessment of the probability and consequences of environmental hazards of pests of uncultivated plants often involves greater uncertainty than for pests of cultivated plants. This is due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats.</p> |   |   |
| <p><b>Evaluate the probability of entry and indicate the elements which make entry most likely or those that make it least likely. Identify the pathways in order of risk and compare their importance in practice.</b></p>   | <p>Very high</p> <p>Low uncertainty</p> | <p>The plant has already entered the EPPO region, and is produced and traded within the European Union and the EPPO region, and imports are recorded as meristem tissue from Indonesia to the Netherlands, and seeds and plants are sold on the Internet.</p> <p>The volume of sold plants in the EPPO countries remains quite low. A survey of nurseries selling the plant mentions that the species is considered expensive and difficult to grow (S. Buholzer, pers. comm., 2009; J van Valkenburg, pers. comm., 2009; G Schrader, pers. comm., 2009). When planted along streams, the plant has the ability to spread mostly by seeds to unintended habitats.</p> |

| Question  | Rating + uncertainty                      | Explanatory text of rating and uncertainty   |
|---|---|--|
| <p><b>Evaluate the probability of establishment, and indicate the elements which make establishment most likely or those that make it least likely. Specify which part of the PRA area presents the greatest risk of establishment.</b></p> | <p>Very high<br/><br/>Low uncertainty</p> | <p>The species is already established in at least 11 EPPO countries, and is recorded in natural habitats protected by EU Habitats Directive 92/43/EEC, or under national legislation (e.g. in Switzerland the Nature and Cultural Heritage Protection Act (NHG))<br/>Where planted under Northern and Western climates and in wetland habitats, <i>L. americanus</i> is able to establish by producing seeds and reproducing vegetatively. Seeds or parts of the plants usually fall near the parent plants, but can also be spread through water or human activities. The spread through animals cannot be quantified and is not considered to be a significant pathway for spread.</p> <p>The probability of introduction to areas of the EPPO region where it is currently not present is high or even very high. Nevertheless, if detected at an early stage, the species can be eradicated.</p> |
| <p><b>List the most important potential economic impacts, and estimate how likely they are to arise in the PRA area. Specify which part of the PRA area is economically most at risk.</b></p>   |   | <p><b>Economic impacts are considered to be low:</b> they only consist in the costs of control measures are not known for all countries, but they differ significantly.</p> <p><b>Environmental impacts they are considered to be low to moderate:</b> <i>Lysichiton americanus</i> occurs in swamp woods and associated wetlands which are rare habitats containing endangered species (see also Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora).<br/>In Germany, where <i>L. americanus</i> was planted in such natural area, it has displaced endangered species.<br/>Otherwise, when not directly planted in natural areas, no significant impact has been recorded so far.</p> <p><b>No social impacts are reported.</b></p>  |

| Question   | Rating + uncertainty | Explanatory text of rating and uncertainty   |
|--|----------------------|--|
| <p><b>The risk assessor should give an overall conclusion on the pest risk assessment and an opinion as to whether the pest or pathway assessed is an appropriate candidate for stage 3 of the PRA: the selection of risk management options, and an estimation of the associated pest risk.</b></p> |                      | <p>Considering the wide distribution of <i>Lysichiton americanus</i> into the EPPO region (present in at least 11 countries), its relatively small importance for import and trade, its moderate ability to spread, the few stands where impacts to biodiversity are reported, its very restricted habitats, the fact that it has been directly planted in the German site where impacts are reported, it is considered that the species does not qualify as a quarantine pest. Prevention measures at the international level are not considered appropriate, but national action of monitoring, communication and eradication are encouraged.</p> <ul style="list-style-type: none"> <li>- Impacts of the species when planted in natural areas are acknowledged, and the implementation of the EU Habitat Directive (92/43/EEC) or national legislations (e.g. in Switzerland the Nature and Cultural Heritage Protection Act (NHG)) prohibiting the introduction of exotic species in natural habitat should be followed and promoted. Fines could be implemented for planting the species into the wild.</li> <li>- General monitoring in EPPO member countries of exotic species, followed by rapid action is also recommended. When recorded in or near wetland habitats, the species should be eradicated. After eradication, monitoring only needs to be performed every 2 years since only older plants (3 years or older) of <i>L. americanus</i> are producing seeds, and this should be undertaken for a duration of at least 8 years (duration of the seed bank).</li> <li>- National legislation should allow and ease the execution of such eradication. Management mainly consists in manual removal of the plant and subsequent monitoring in wetland habitats.</li> <li>- Communication to the public could be enhanced. In Switzerland, the species has been registered on a black list, which helped raising awareness in the nursery sector. In Germany, no black list exist, but the media are interested in the topic of invasive alien plants, and articles were released on <i>Lysichiton americanus</i>. Involvement of the public is important so that there is no opposition to management measures.</li> </ul> |

| Question | Rating + uncertainty | Explanatory text of rating and uncertainty  |
|----------|----------------------|---|
|          |                      | <p>- Cooperation with the nursery industry through the implementation of a code of conduct (see Heywood &amp; Brunel, 2009) seems particularly appropriate for this species. The species should be carefully labelled with a mention that the species should only be planted in ponds isolated from at least 50 m away from running water. Wastes containing seeds or rhizomes of the plant should not be disposed into the wild. Substitution species are also available like <i>Calla palustris</i> in Switzerland, but substitution species have to be chosen on a country basis. See also a German initiative providing information and recommendations on the plant to professionals (including the PPP index): <a href="http://www.g-net.de/download/Empfehlung-Invasive-Arten.pdf">http://www.g-net.de/download/Empfehlung-Invasive-Arten.pdf</a>. <i>L. camtschatcensis</i> has been suggested by professionals as an alternative species, this species is not considered as appropriate since it is very close to <i>L. americanus</i>, and has been found growing in the wild in the Taunus (Alberternst B &amp; Schmitz , 2002). In France, the Conservatoire Botanique de Bailleul implemented a voluntary code of conduct with the professionals which recommend to stop the trade of invasive alien plants.</p> <p>See the EPPO Standard PM 3/67 'Guidelines for the management of invasive alien plants or potentially invasive alien plants which are intended for import or have been intentionally imported'.</p> |

|   |  |
|---|--|
| This is the end of the Pest risk assessment |  |
|---|--|

## References

- Alberternst B & Nawrath S (2002) *Lysichiton americanus* Hultén & St. John neu in Kontinental-Europa. Bestehen Chancen für die Bekämpfung in der Frühphase der Einbürgerung? [*Lysichiton americanus* Hultén & St. John new in Continental Europe. Is there a chance for control in the early phase of naturalization?]. *Neobiota* 1: 91-99.
- Alberternst B & Nawrath S (2001) *Lysichiton americanus* in Central Europe – is there a chance to control the invasive species in the early phase of naturalization? In: Kowark, I & Starfinger U (2001): Biological Invasions in Germany – A Challenge to Act. BfN-Skripten 32: 37-38.
- Alberternst B & Schmitz G (2002) Vorkommen von *Lysichiton camtschatcensis* (L.) Schott im Taunus. *Florist. Rundbr.* 36 (1/2): 113-118
- Anon. (2006) Invasive plants: Scottish lochs fall foul to skunk cabbage. *The Garden*, January 2006, Volume 131; Part 1. Royal Horticultural Society.
- Åsen A (2002) SKUNK-KALLA *Lysichiton americanus*. Agder Naturmuseum og Botaniske hage's. [http://www.museumsnett.no/naturmuseum/tusenaarshagen/lysichiton\\_americanus.shtml](http://www.museumsnett.no/naturmuseum/tusenaarshagen/lysichiton_americanus.shtml)
- Barker J. Randall R. & Grice T (2006) *Weeds of the future?. Threats to Australia's grazing industries by garden plants*. Co-operative Research Centre for Australian Weed Management. Project code: NBP.357. ISBN: 1 74036 781 2. Publish by Meat & Livestock Australia Limited. Australia.
- Britton & Brown (1913): *Illustrated Flora - 2nd Edition. An Illustrated Flora of the Northern United States and Canada, Medicinal Plant excerpts*, [http://www.swsbn.com/Britton-Brown/Symplocarpus\\_foetidus.gif](http://www.swsbn.com/Britton-Brown/Symplocarpus_foetidus.gif).
- Buttler, K P & Hand, R (2008): *Liste der Gefäßpflanzen Deutschlands. Kochia, Beiheft 1: 1-107*. Berlin.
- Branquart E, Vanderhoeven S, Van Landuyt W, Van Rossum F and Verloove (2007) Invasive species in Belgium. *Lysichiton americanus* – American skunkcabbage. Available from the website of the Belgian Forum on Invasive Species: <http://ias.biodiversity.be/ias/species/detail/13>
- Branquart E, Vanderhoeven S, Wouter V L, Fabienne V R & Filip V (2007) *Lysichiton americanus* - American skunk cabbage. Belgian Forum on Invasive Species (BFIS), (2007). <http://ias.biodiversity.be/ias/species/show/13>
- Bratland B, Bratland B & Kortner C (2000) 14. mai til Kalvehageneset ved Homborsund og Tromøya ved Arenda. [14 of May from Kalvehageneset at Homborsund to Tromoya at Arenda] *Journal of the Norwegian Botanical Society*, **58** (3-4): p. 143.
- BSBI (2009). Hectad distribution map of *Lysichiton americanus* (American Skunk-cabbage) in Britain and Ireland. Botanical Society of the British Isles (BSBI). <http://www.bsbi.org.uk/index.html>
- Clement E J, Foster M C (1994) *Alien Plants of the British Isles*. – London (Botanical Society of the British Isles), 590 pp.
- Convention on the Conservation of European Wildlife and Natural Habitats (2007) Bern Convention Group of Experts on Invasive Alien Species. Implementation of recommendations on the Invasive Alien Species. Reykjavik, Iceland, (22-24 May 2007). 67 p.

CORINE LANDCOVER (2009) <http://dataservice.eea.eu.int/download.asp?id=5859&type=gif>. Website visited in March 2009.

Cox K & Curtis-Machin R (2008) Garden Plants for Scotland. Francis Lincoln Ltd, ISBN 071122675X, 9780711226753, 240 p.

CPS/SKEW (2006) Espèce de la Liste Noire. Lysichite jaune. Swiss Commission for Wild Plant Conservation CPS/SKEW. Last modified 28.03.2008. [http://www.cps-skew.ch/francais/inva\\_lysi\\_ame\\_f.pdf](http://www.cps-skew.ch/francais/inva_lysi_ame_f.pdf)

D'Amore D V & Lynn W C (2002) Classification of Forested Histosols in Southeast Alaska *Soil Science Society of America Journal* 66:554-562.

Delaigue J (2001) *Tanacetum macrophyllum* (Waldst. Et Kit.) Schultz Bip. (Asteraceae), plante nouvelle pour la France, dans le Massif du Mont Pilat. [*Tanacetum macrophyllum* (Asteraceae), new plant for France, on the Mont Pilat Massif.] *Bulletin mensuel de la Société Linnéenne de Lyon*, 70(4), 93-103. in EPPO, 2005. EPPO (European and Mediterranean Plant Protection Organisation) 2005. Reporting service, No 11, 2005/171, p. 2.

Doyle G J, Duckett J G (1985) The Occurrence of *Lysichiton americanus* on Woodfield Bog County Offaly Ireland. - *Irish Naturalists' Journal* 21(12): 536-538.

Edqvist M & Karlsson T (red) (2007) *Smålands flora. [Flora of Småland]* SBT-förlaget, Uppsala.

EFSA (2007) Opinion of the EFSA Scientific Panel on Plant Health on request from the Commission on Pest Risk Analysis made by EPPO on *Lysichiton americanus* Hultén & St. John (American or yellow skunk cabbage), *The EFSA Journal*, 539, 1-12 pp.

Ellenberg H, Weber H E, Düll R, Wirth V, Werner W & Paulissen D (1992) Zeigerwerte von Pflanzen in Mitteleuropa. *Scripta Geobotanica* 18: 1-248.

EPPO (2004) *Lysichiton americanus* (Araceae): addition to the EPPO Alert List. *Reporting Service*. Paris, 2004-10-01 Reporting Service 2004, No. 10. 12-15

EPPO (2006) Data sheets on quarantine pests *Lysichiton americanus*. *Bulletin OEPP/EPPO Bulletin* 36, 7-9.

EPPO (2009) Pathway analysis: aquatic plants imported into some EPPO region. *Bulletin OEPP/EPPO Bulletin*. **To be published.**

Fischer E, Schausten H (1994) Botanisch-floristischer Jahresbericht für den Regierungsbezirk Koblenz 1992/1993 [Botanical-floristical annual report for the administrative district of Koblenz 1992/1993]. – Fauna und Flora in Rheinland Pfalz Beihefte 11: 140-167. In Klingenstein F. and Alberternst B. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – From: Online Database of the North European and Baltic Network on Invasive Alien Species - NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access 02/03/2009.

Fish and Wildlife Service (1996) National List of Vascular Plant Species That Occur in Wetlands. <http://www.fws.gov/nwi/Plants/list96.html#copyright>

Flora of Northern Ireland (2004) *Lysichiton americanus*. <http://www.habitas.org.uk/flora/>



FloraWeb (2006) *Lysichiton americanus* Hulten & St. John (Araceae), Amerikanischer Stinktierkohl. Neoflora. Invasive gebietsfremde pflanzen in Deutschland. <http://www.floraweb.de/neoflora/handbuch/lysichitonamericanus.html>

FNA (1993) *Lysichiton americanus*. Flora of North America. FNA. Vol.22. Accessed date: 1/03/2009. [http://www.efloras.org/florataxon.aspx?flora\\_id=1&taxon\\_id=222000246](http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=222000246)

Fuchs R, Kutzelnigg H, Feige B & Keil P (2003) Verwilderte Vorkommen von *Lysichiton americanus* Hultén & St. John (Araceae) in Duisburg und Mülheim an der Ruhr [Savaged occurrence of *Lysichiton americanus* Hultén & St. John (Araceae) in Duisburg and Muelheim an der Ruhr]. *Tuexenia* 23: 373-379. In: Fuchs, R. (2008). *Semi-natural ancient forest in an urban agglomeration area and its neophyte dynamics*. In: Rabitsch, W., F. Essl & F. Klingenstein (Eds.): *Biological Invasions – from Ecology to Conservation*. NEOBIOTA 7: 238-249.

Fuchs R (2008) *Semi-natural ancient forest in an urban agglomeration area and its neophyte dynamics*. In: Rabitsch, W., F. Essl & F. Klingenstein (Eds.): *Biological Invasions – from Ecology to Conservation*. NEOBIOTA 7: 238-249.

Gillingham M P, Parker K L & Hanley T A (1997) Forage intake by black-tailed deer in a natural environment. *Canadian Journal of Zoology*, vol. 75(7): 1118-1128.

Gillingham M P, Parker K L & Hanley T A (2001) Habitat use black-tailed deer in relation to rate of forage intake. *Alces*, vol. 37(2): 339-352.

Global Compendium of Weeds (2007) *Lysichiton americanus* (Araceae). [http://www.hear.org/gcw/species/lysichiton\\_americanus/](http://www.hear.org/gcw/species/lysichiton_americanus/)

Greenlee J T (1998) Ecologically significant wetlands in the Flathead, Stillwater, and Swan River valleys. Unpublished report to the Montana Department of Environmental Quality. Montana Natural Heritage Program, Helena, MT. 192 pp.

Gyug L, Hamilton T & Austin M (2004) Grizzly bear *Ursus arctos*. Accounts and Measures for Managing Identified Wildlife – Accounts V. 2004. [www.env.gov.bc.ca/wld/frpa/iwms/documents/Mammals/m\\_grizzlybear.pdf](http://www.env.gov.bc.ca/wld/frpa/iwms/documents/Mammals/m_grizzlybear.pdf)

Hanley T A & Brady W W (1996) Understory species composition and production in old-growth western hemlock – Sitka spruce forests of southeastern Alaska. *Can. J. Bot.* 75: 574-580.

Heywood V & Brunel S (2009) Code of conduct on horticulture and invasive alien plants. Convention on the Conservation of European wildlife and natural habitats. 33 p.

Herdam H (1994a) Neufunde und Nachträge zu Herdam *et al.*: Neue Flora von Halberstadt (1. Mitteilung). – Mitteilungen des Botanischen Arbeitskreises Nordharz 1: 1-49. In Klingenstein F. and Alberternst B. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – From: Online Database of the North European and Baltic Network on Invasive Alien Species - NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access 02/03/2009.

Herdam H (1994b) Neufunde und Nachträge zur "Neuen Flora von Halberstadt" 2. Mitteilung. – Abhandlungen und Berichte des Museums Heineanum 2: 1-71. In Klingenstein F. and Alberternst B. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – From: Online

Database of the North European and Baltic Network on Invasive Alien Species - NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access 02/03/2009.

Hickman J C eds (1993) *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley (US). [http://books.google.co.uk/books?id=sTR5\\_CQ-yAC&printsec=frontcover&dq=hickman,+1993,+lysichiton&source=gb\\_s\\_summary\\_s&cad=0#PPA1104\\_M1](http://books.google.co.uk/books?id=sTR5_CQ-yAC&printsec=frontcover&dq=hickman,+1993,+lysichiton&source=gb_s_summary_s&cad=0#PPA1104_M1)  
[http://www.coe.int/t/dg4/cultureheritage/conventions/Bern/T-PVS/sc24\\_inf04\\_en.pdf](http://www.coe.int/t/dg4/cultureheritage/conventions/Bern/T-PVS/sc24_inf04_en.pdf)

Jörg E (2009) *Lysichiton americanus* Hultén & St. John - lysichite jaune ou faux arum (Araceae). Une nouvelle espèce envahit la Suisse! Canton de Berne. [http://www.vol.be.ch/site/fr/lanat-3.3.7-telechargements-lysichiton\\_f\\_1\\_.pdf](http://www.vol.be.ch/site/fr/lanat-3.3.7-telechargements-lysichiton_f_1_.pdf)

Keil P, Fuchs R, Loos G H, Berg T, Gausmann P & Buch C (2008) *New records of neophytes from the "Ruhrgebiet", a hotspot of alien species in Germany*. In: Pyšek P. & Pergl J. (eds) 2008. Towards a synthesis: Neobiota book of abstracts. Institute of Botany Průhonice, Academy of Sciences, Czech Republic. Link?

Klingenstein F & Alberternst B (2006) NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – From: Online Database of the North European and Baltic Network on Invasive Alien Species - NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access 02/03/2009.

Klingenstein F & Schepker H (2005) *A national survey as "button up approach" to detect invasive plant species in Germany*. 8<sup>th</sup> International Conference on the ecology and Management of Alien Plant Invasions, 5-12 September, 2005, Katowice, Poland, pp.2

Klinkenberg B (2008) *Lysichiton americanus* Hult. & St. John American skunkcabbage; skunk cabbage. *Araceae*. E-Flora BC: Electronic Atlas of the Plants of British Columbia. <http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Lysichiton%20americanus>

König A & Nawrath S (1992) *Lysichiton americanus* Hultén and St. John (Araceae) im Hochtaunus [*Lysichiton americanus* Hultén and St. John in the High Taunus]. – Botanik und Naturschutz in Hessen 6: 103-107.

Korneck D & Krause A (1990) *Lysichiton americanus* Hultén and St. John (Araceae), ein Neophyt im Hochtaunus [*Lysichiton americanus* Hultén and St. John (Araceae), a neophyte in the Hochtaunus]. - Hessische Floristische Briefe 39(4): 53-56. In Klingenstein F. and Alberternst B. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – From: Online Database of the North European and Baltic Network on Invasive Alien Species - NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access 02/03/2009.

Lansdown R V (2008) *A field guide to the riverine plants of Britain and Northern Ireland. Including selected vascular plants, bryophytes, lichens and algae*. Environment Agency, Thames Region. pp.77

Larson D (2003) Predicting the threats to ecosystem function and economy of alien vascular plants in freshwater environments. - Department of Environmental Assessments, Swedish University of Agricultural Sciences Report 2003: 7.

Lebreton A (2007) Présence du Lysichite jaune ou Faux arum, *Lysichiton americanus* Hultén & St John (Araceae), en France. *Symbioses*, nouvelle série, n° 20 : 60– 64

Lenfors I, Nilsson N G (1987) Två nordamerikanska araceer i Halland [*Orontium aquaticum* and *Lysichiton americanus* found in S Halland]. - Svensk Botanisk Tidskrift 81 (1): 37-39. In Klingenstein F. and Alberternst B. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – From: Online Database of the North European and Baltic Network on Invasive Alien Species - NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access 02/03/2009.

Lid J, Lid D T (1994) Norsk flora. (R. Elven, ed.) – Det norske samlaget, Oslo. In Klingenstein F. and Alberternst B. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – From: Online Database of the North European and Baltic Network on Invasive Alien Species - NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access 02/03/2009.

Lind F (1988) Östergötlands flora – tillägg och rättelser 5 [= The flora of Ostergotland - additions and corrections 5]. - Svensk Botanisk Tidskrift 82 (1): 43-46. In Klingenstein F. and Alberternst B. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – From: Online Database of the North European and Baltic Network on Invasive Alien Species - NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access 02/03/2009.

McClellan M H, Brock T & Baichtal J F (2003) Calcareous fens in Southeast Alaska. Res. Note PNW-RN-536. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. [http://www.fs.fed.us/pnw/pubs/pnw\\_rm536.pdf](http://www.fs.fed.us/pnw/pubs/pnw_rm536.pdf)

Minchin D (2007) A checklist of alien and cryptogenic aquatic species in Ireland. *Aquatic Invasions* Vol. 2 (4): 341-366. [http://www.aquaticinvasions.ru/2007/AI\\_2007\\_2\\_4\\_Minchin.pdf](http://www.aquaticinvasions.ru/2007/AI_2007_2_4_Minchin.pdf)

Missouri Botanical Garden (2009) Current Specimen List for *Lysichiton americanus*. [http://mobot.mobot.org/cgi-bin/search\\_vast](http://mobot.mobot.org/cgi-bin/search_vast)

National Biodiversity Data Centre Website (Ireland)  
<http://www.biodiversityireland.ie/>

NatureServe (2005) International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 19 October 2005. [https://transfer.natureserve.org/download/longterm/Ecological\\_Classification/wclas2a.pdf](https://transfer.natureserve.org/download/longterm/Ecological_Classification/wclas2a.pdf)

Nature and Cultural Heritage Protection Act (NHG) in Switzerland  
Loi fédérale du 1<sup>er</sup> juillet 1966 sur la protection de la nature et du paysage (LPN)  
<http://www.admin.ch/ch/f/rs/c451.html>

Neoflora website – Datasheet on *Lysichiton americanus* (in German)  
<http://www.floraweb.de/neoflora/handbuch/lysichitonamericanus.html>

Nicolson D H (1981) The Gender of *Lysichiton* Schott (Aracea). *Aroideana* 4: 23-24.  
NBN (2004a). Grid map of records on the Gateway for American Skunk-cabbage (*Lysichiton americanus*) in Great Britain and Ireland. National Biodiversity Network (NBN).  
<http://data.nbn.org.uk/gridMap/gridMap.jsp?allIDs=1&srchSpKey=NHMSYS0000460540>

NBN (2008) Grid map of records on the Gateway for Asian Skunk-cabbage (*Lysichiton camtschaticensis*) in Great Britain and Ireland. National Biodiversity Network (NBN).  
<http://data.nbn.org.uk/gridMap/gridMap.jsp?allIDs=1&srchSpKey=NBNSYS0000033298>

Nie Z L, Sun H, Li H & Wen J (2006) Intercontinental biogeography of subfamily Orontioideae (Symlocarpus, Lysichiton, and Orontium) of Araceae in eastern Asia and North America. *Molecular Phylogenetics and Evolution* 40: 155-165.

O'Mahony T (1975) First county and vice-county records for Cork plants. *Irish Naturalists' Journal* 18: 238-241

Ohwi J (1984): Flora of Japan. Washington. 1067 p.

O'Malley J (1996) New plant records from South Kerry (H1) and North Kerry (H2). - *Irish Naturalists' Journal* 25 (8): 298-299.

Peeters-Van der Meijden K & Rotteveel T (2006) *Lysichiton americanus* Hultén & H. St. John, een imposante indringer. [*Lysichiton americanus* Hultén & H. St. John, an alien invasive species]. *Gorteria* 32-2: 37-44.

Pellmyr O & Patt J A (1986) Function of visual and olfactory attractants in the pollination of *Lysichiton americanum* (Araceae) by a staphylinid beetle. - *Madroño* 33: 47-54.

Peters J V (1960) Rapid spread of *Lysichiton camtschaticum*. *Irish Naturalists Journal*, 13: 182-183

Pieret N & Delbart E (2009) Fiches descriptives des principales espèces de plantes invasives en zones humides. Le lysichite jaune – *Lysichiton americanus* Hultén & St. John. <http://www.fsagx.ac.be/ec/gestioninvasives/Documents/Fiche%20ecologiqueLysichitonamericanusbis.pdf>

PPP-Index website. Pflanzeneinkaufsführer für Europa. <http://www.ppp-index.de/> (Last visit in March 2009)

Plants for a future Website – *Lysichiton americanus*  
<http://www.pfaf.org/database/plants.php?Lysichiton+americanus>

Preston CD & Croft JM (1997) Aquatic plants in Britain and Ireland. Harley Books, Colchester Preston

Preston CD, Pearman DA & Dines TD (eds) (2002) New Atlas of the British and Irish Flora: an atlas of the vascular plants of Britain, Ireland, the Isle of Man and the Channel Islands. Oxford University Press, 910 pp.

Reed P B (1988) National list of plant species that occur in wetlands: Alaska (region A). US Department of the Interior, Fish and Wildlife Service, Washington, DC. , Biological Report 88(26.11). 86 pp. In: McClellan, M. H. Brock, T. and Baichtal, J. F. (2003). *Calcareous fens in Southeast Alaska. Res. Note PNW-RN-536. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.* [http://www.fs.fed.us/pnw/pubs/pnw\\_rn536.pdf](http://www.fs.fed.us/pnw/pubs/pnw_rn536.pdf)

Reynolds S C P (2002) A catalogue of alien plants in Ireland. [Alismataceae, Hydrocharitaceae, Aponogetonaceae, Araceae, Juncaceae, Lemnaceae, Cyperaceae.](http://www.botanicgardens.ie/glasra/aliens/275_282.pdf) National Botanic Gardens, Glasnevin, Dublin. [http://www.botanicgardens.ie/glasra/aliens/275\\_282.pdf](http://www.botanicgardens.ie/glasra/aliens/275_282.pdf)

RHS (2009) Royal Horticultural Society. [http://www.rhs.org.uk/rhsplantfinder/plantfinder2.asp?crit=lysichiton&Genus=Lysichiton.](http://www.rhs.org.uk/rhsplantfinder/plantfinder2.asp?crit=lysichiton&Genus=Lysichiton)

Rosendahl C O (1911) Observation on the morphology of the underground stems of *Symplocarpus* and *Lysichiton*, together with some notes on geographical distribution and relationship. *Minnesota Botanical Studies* 4, 137-152.

Rotteveel AJW (2007) Initial eradication of *Lysichiton americanus* from the Netherlands. Abstract of the EWRS-Symposium in Hamar, Norway 2007-06-17/21, p. 36.

Ryttäri T, Aspelund P, Eerola L & Vuorinen E (2006) Keltamavankaali aikeissa villiintyä Pohjassa – ja ehkä muuallakin Suomessa? [American Skunk-cabbage (*Lysichiton americanus*) is spreading in Finland]. *Lutukka* 22: 118-122. <http://www.fmnh.helsinki.fi/english/publications/lutukka/summaries/2006-4.htm>

Schott, H W (1857): Aroideae. Oesterreichisches Botanisches Wochenblatt. Nr. 8: 61-62. Schönbrunn.  
Simon Hallstan (2005) Global warming opens the door for invasive macrophytes in Swedish lakes and streams. Master's thesis. Department of Environmental Assessment, Swedish University of Agricultural Sciences, Uppsala

St. John H & Hultén E (1956) A comment on the generic names *Lysichiton* and *Lysichitum*. *Bulletin of the Torrey Botanical Club* Vol. 83, No. 2: 151-153.

Thomas M G & Schumann D R (1993) Income Opportunities in Special Forest Products--Self-Help Suggestions for Rural Entrepreneurs. Agriculture Information Bulletin AIB666, U.S. Department of Agriculture, Washington, DC <http://www.fpl.fs.fed.us/documnts/usda/agib666/aib666in.pdf>

Tutin T G, Heywood V H, Burges N A & Valentine DH [eds.] (1980) Flora Europaea Volume 5: Alismataceae to Orchidaceae. – Cambridge [u.a.] (Cambridge University Press), 476 pp.

USDA, ARS, National Genetic Resources Program (2009) *Germplasm Resources Information Network - (GRIN)* [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. <http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?23003#common>

Vanderhoeven S, Branquart E, Grégoire J C & Mahy G (2007) Les invasions biologiques. *Forêt wallonen, 89. juillet août.*

Verlove F (2006) in DAISIE, 2009. *Lysichiton americanus x camtschatcensis*. DAISIE European Invasive Alien Species Gateway, 2009. Available from: <http://www.europe-alien.org/speciesInRegion.do?speciesInRegionId=676;5783> [Accessed 1st March 2009].

Waarneming.nl (2009) *Moeraslantaarn Lysichiton americanus*. <http://waarneming.nl/soort/view/18775?from=2004-03-16&to=2009-03-16&species=18775&prov=0&akt=0&from=2004-03-16&to=2009-03-16&prov=0>

Washington Department of Education Datasheet  
<http://depts.washington.edu/propplnt/Plants/skunkcabbage.htm>

Webb DA, Parnell J & Doogue D (1996) An Irish Flora, 7th Ed. Dundalgen Press, Dundalk, Ireland, 337 pp.

Wild about Denmark (2009) American Skunk-cabbage (*Lysichiton americanus*). Updated 2009 Feb 23, accessed February 26, 2009. <http://www.fugleognatur.dk/wildaboutdenmark/speciesintro.asp?ID=5938&dknavn=Gul%20Kæmpekalla&latin=Lysichiton%20americanus>

Willson MF & Hennon PE (1997) The natural history of western skunk cabbage (*Lysichiton americanus*) in southeast Alaska. *Canadian Journal of Botany* **75**, 1022–1025.

Zipcodezoo (2009) *Lysichiton americanus* Revised date: 03/03/2009.  
[http://zipcodezoo.com/Plants/L/Lysichiton\\_americanus/Default.asp](http://zipcodezoo.com/Plants/L/Lysichiton_americanus/Default.asp)

Zentralverban Gartenbau e.V. (2008): Umgang mit invasiven Arten. Empfehlungen für Gärtner, Planer und Verwender. <http://www.g-net.de/download/Empfehlung-Invasive-Arten.pdf>

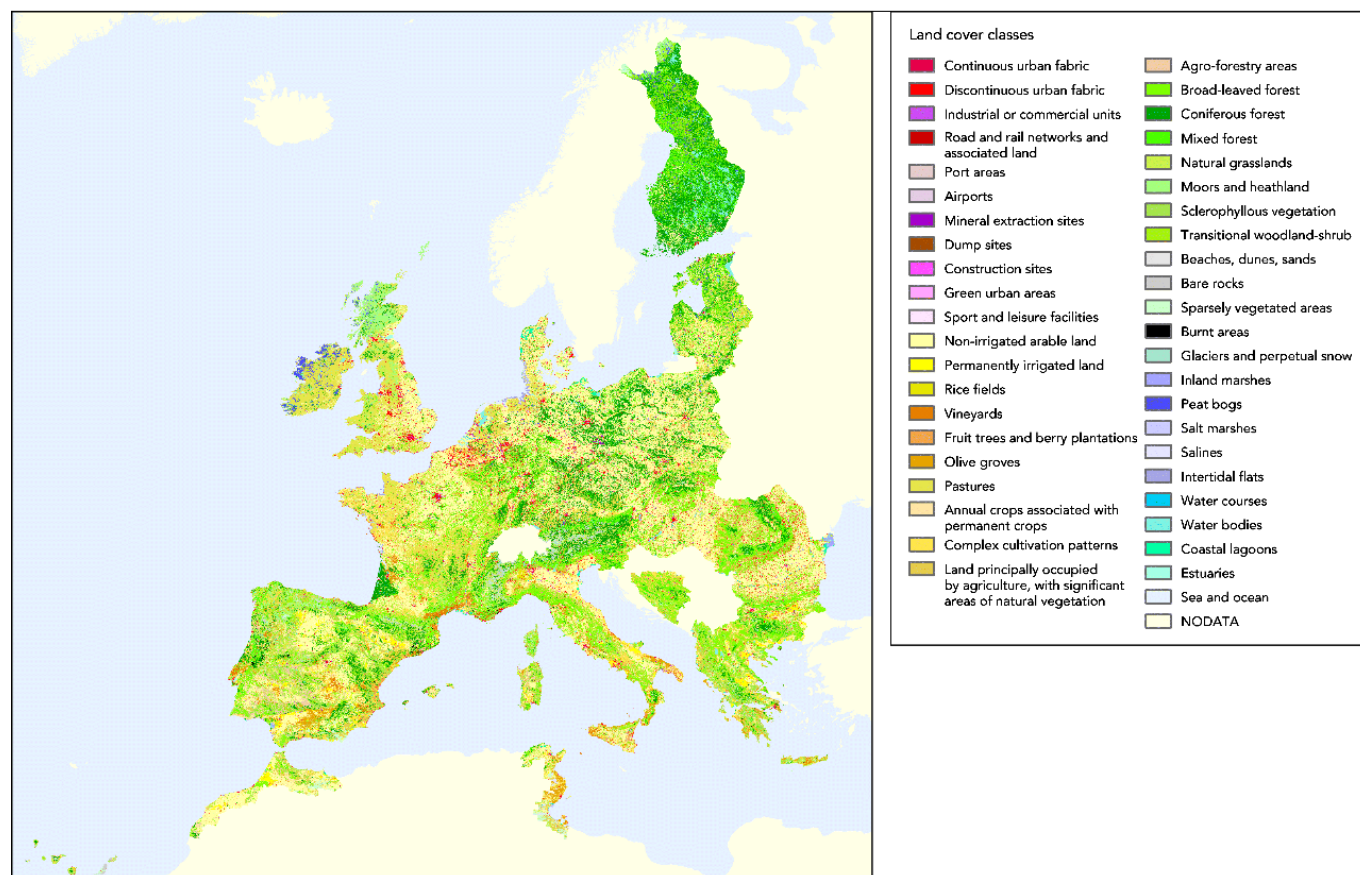


## Appendix 1

### Maps relevant for the distribution of *Lysichiton americanus*

#### CORINE land cover classification

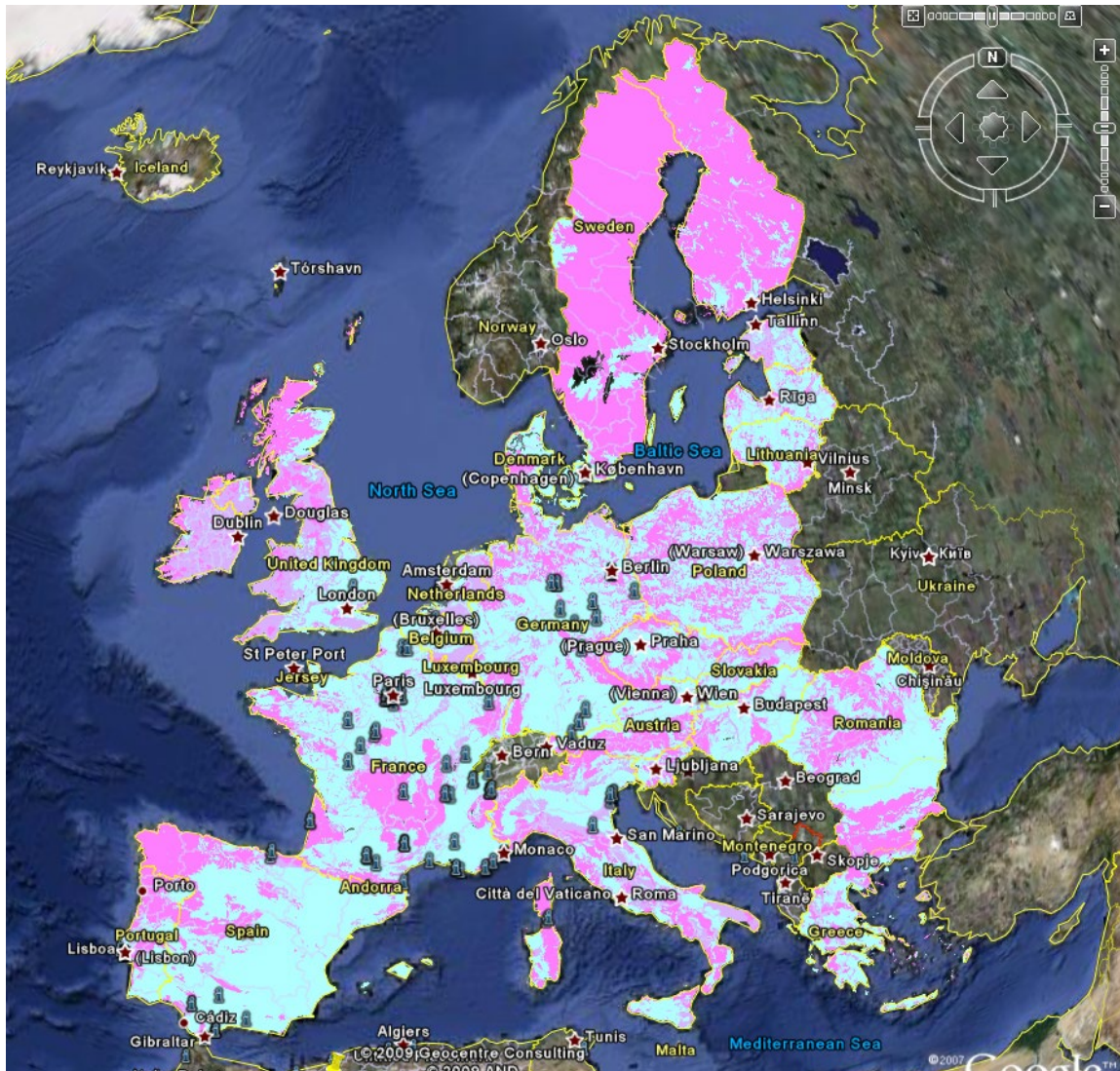
<http://dataservice.eea.eu.int/download.asp?id=5859&type=gif>.



#### pH maps

The following map can be found on the European Soil Portal maintained by the European Commission (<http://eusoils.jrc.ec.europa.eu/>, European soil data center > Data > European soil data base > Raster version or Google earth version > chemical properties > base saturation top soil (BS TOP)

The areas in pink (darker) represent acidic soils which are suitable for *Hydrocotyle ranunculoides*.





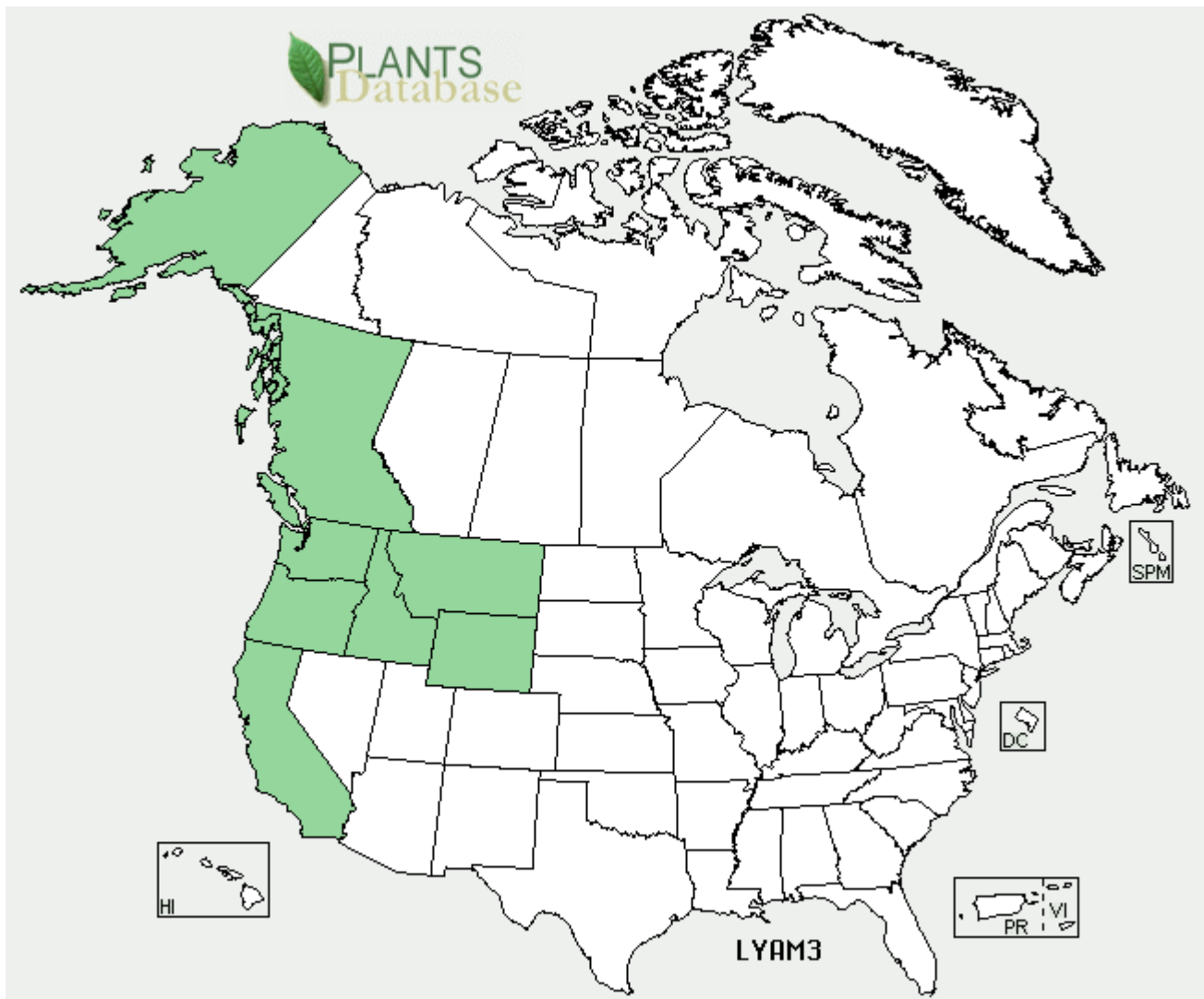
## Appendix 2

### Maps of distribution of *Lysichiton americanus*

#### North America

Map available at <http://plants.usda.gov/java/profile?symbol=LYAM3>


More detail data at the state scale are available on the website.

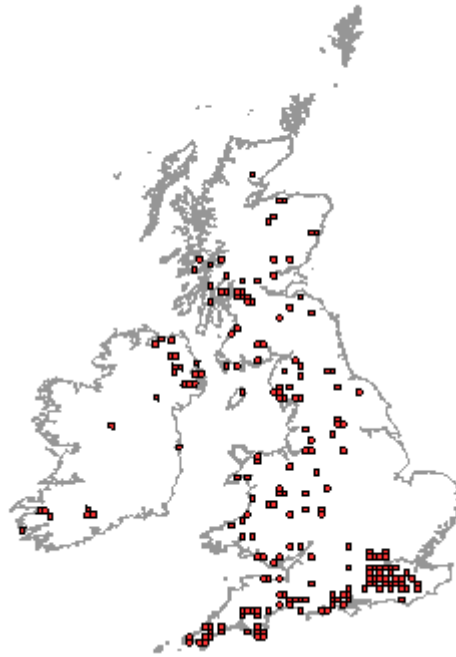


#### The UK

<http://data.nbn.org.uk/gridMap/gridMap.jsp?allIDs=1&srchSpKey=NHMSYS0000460539>

**10km square  
legend**

 Present in 10km squares



© Crown Copyright. All rights reserved NERC 100017897 2004

**Germany**

*Lysichiton americanus* in Germany in 2009 (B. Alberternst, pers. comm., 2009)



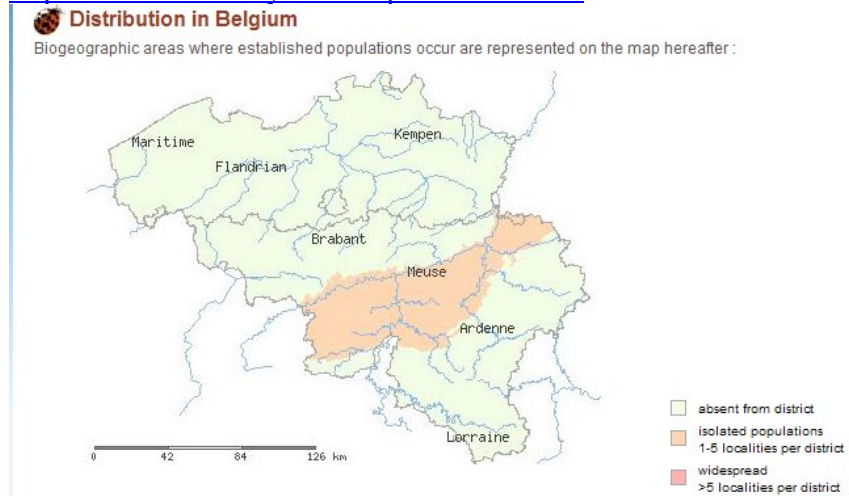
 Site of *Lysichiton americanus*

Source of the underlying map:

[http://upload.wikimedia.org/wikipedia/commons/0/0d/Germany\\_location\\_map.svg](http://upload.wikimedia.org/wikipedia/commons/0/0d/Germany_location_map.svg)

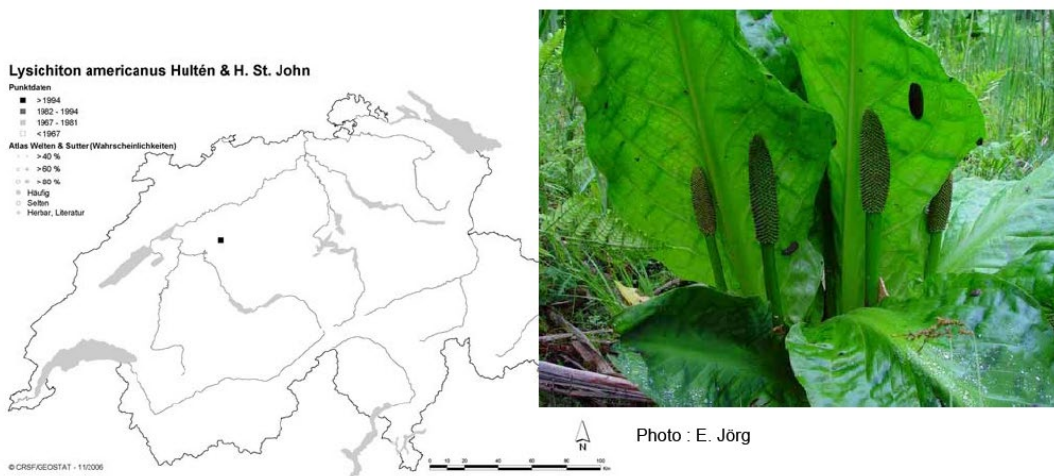
## Belgium

Map available on the website of the Forum for Invasive Species in Belgium at <http://ias.biodiversity.be/ias/species/show/13>



## Switzerland

Map available at: [http://www.cps-skew.ch/francais/inva\\_lysi\\_ame\\_f.pdf](http://www.cps-skew.ch/francais/inva_lysi_ame_f.pdf)



## Appendix 3

### Climatic prediction for *Lysichiton americanus*

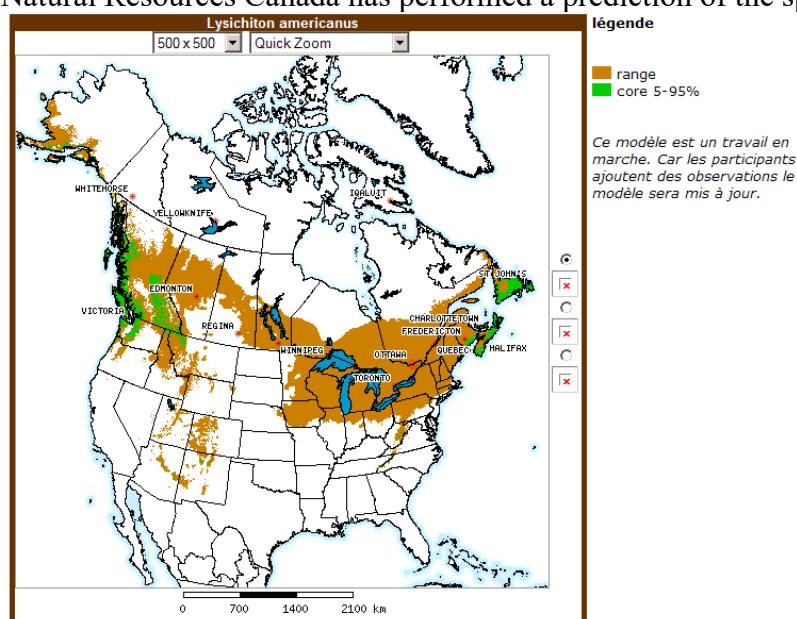
The CLIMEX model is a computer programme aiming at predicting the potential geographical distribution of an organism considering its climatic requirements. It is based on the hypothesis that climate is an essential factor for the establishment of a species in a country.

For *Lysichiton americanus*, a compare location analysis has been undertaken.

#### 1. Geographical distribution of the species

##### *Existing climatic prediction*

Natural Resources Canada has performed a prediction of the species distribution based on current climate.



##### *Phenology*

Inflorescences appear between March and May, emerging and flourishing before the leaves come out. Seeds mature in its native area of distribution from June to July, and in Germany in July or early August. Plants do not flower every year in their native range.

##### *Influence of climatic factors on distribution*

Information from the Jepson Horticultural Database (Hickman, 1993) for *Lysichiton americanus*

Given WET(fresh water), grows especially well in **zones 4 and 5**.

Given SHD,WET(fresh water), grows especially well in **zones 6, 15, 16, and 17** and also in zones 1, 2, 3, 7, 14, 18, and 19.

##### *Soil moisture*

The species only grows in permanently wet soils. The moisture indexes are therefore at the threshold mentioned in the table below.

##### *Temperature index*

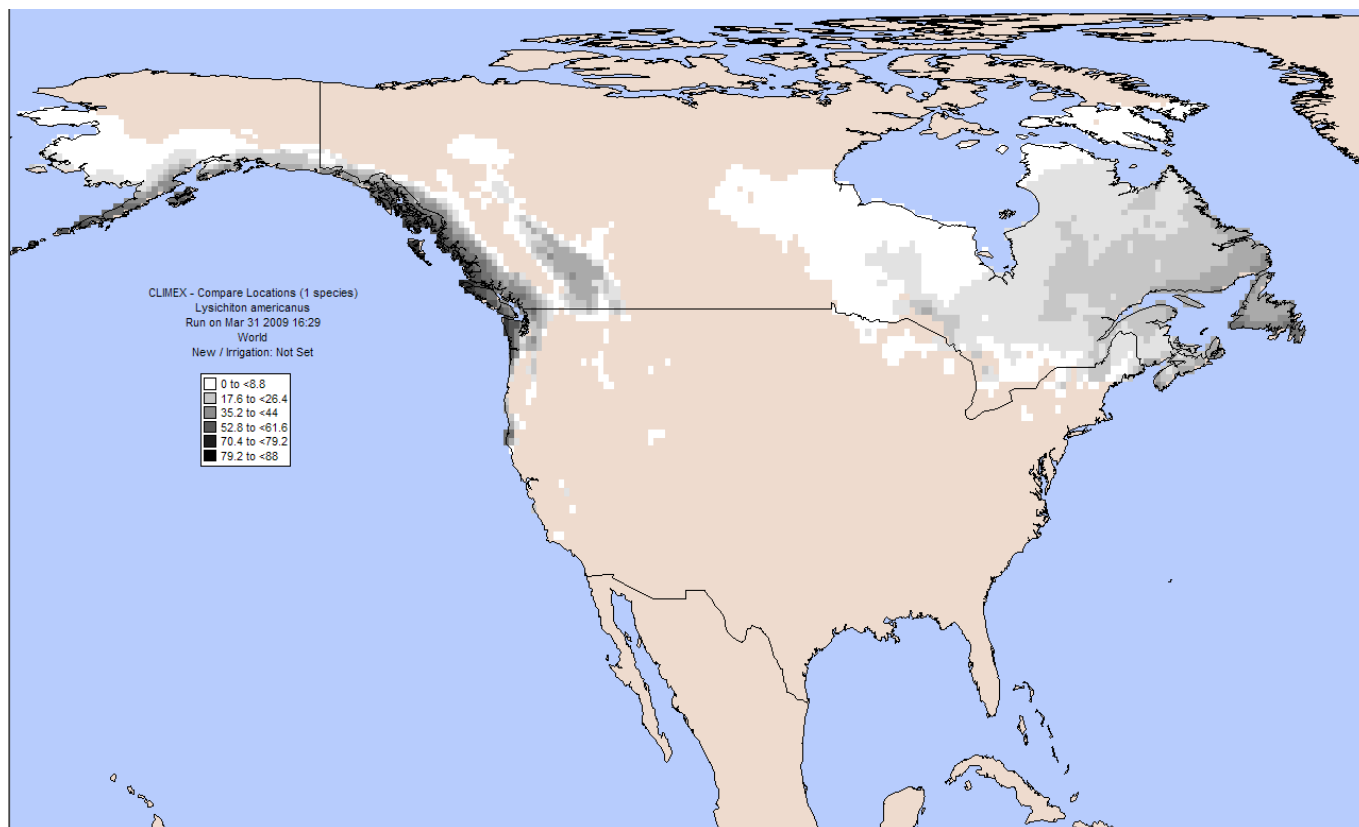
*L. americanus* is typically associated with climates Cf, Dfb and Dfc in Köppen's classification, i.e. cool to hot summer, very cold to cool winter, wet year round. *L. americanus* is hardy at least to zone 7 (−15°C), and possibly colder.

Considering its distribution, the species is considered to grow best between 8 and 15 °C of weekly average temperature, with a range for growth comprised between 0 and 24 C of weekly average temperature.

The species is considered to accumulate stress at -10°C of weekly average temperature, at a low rate (-0.0001). The distribution of *L. americanus* shows that it does not grow well in hot environment. A stress is set at 24°C of weekly average temperature with a rate of 0.003.

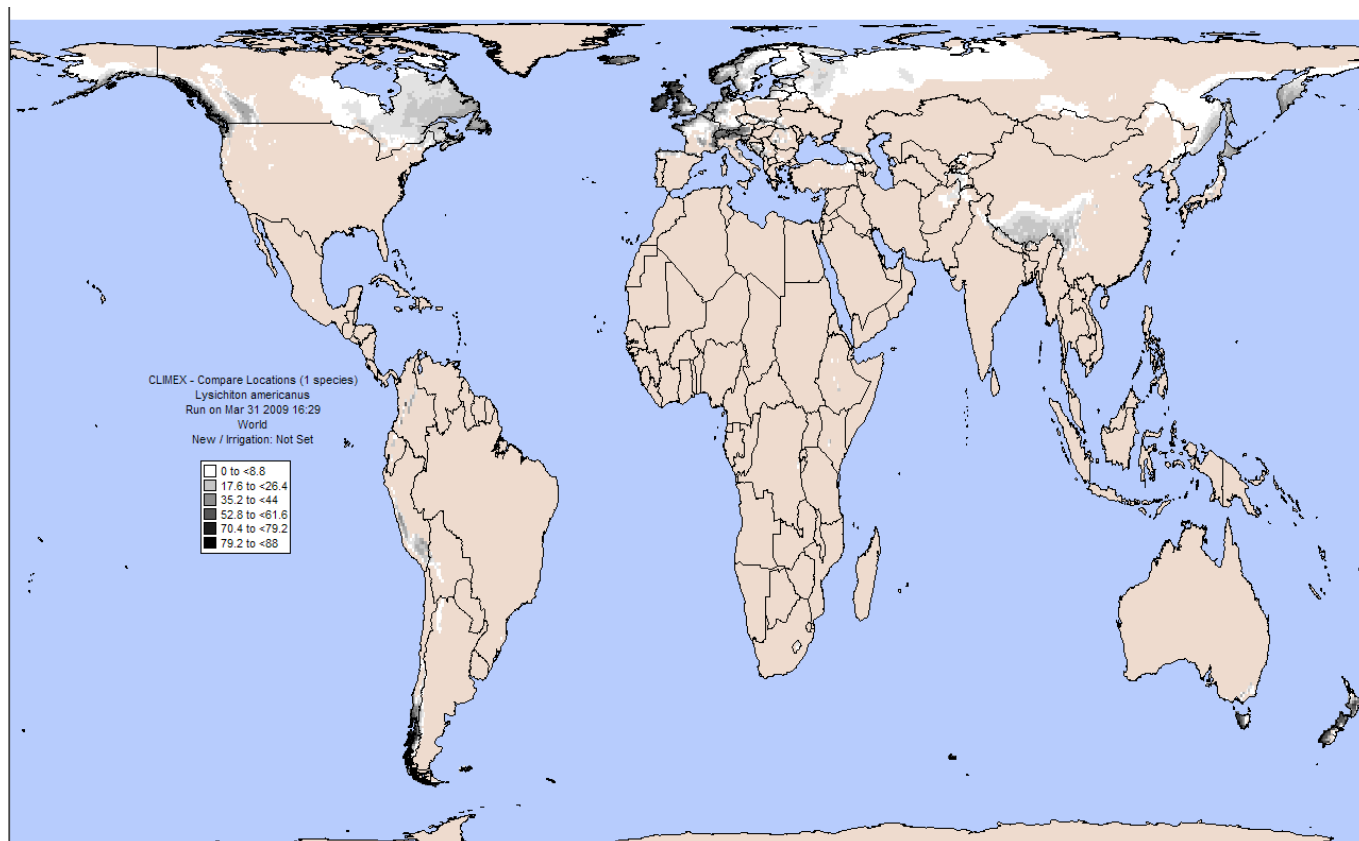
|   |         |      |      |       |       |
|---|---------|------|------|-------|-------|
| <input checked="" type="checkbox"/> Moisture Index    |         |      |      |       |       |
| SM0   | SM1     | SM2  | SM3  |       |       |
| 0.5   | 1       | 2    | 3.5  |       |       |
| <input checked="" type="checkbox"/> Temperature Index |         |      |      |       |       |
| DV0   | DV1     | DV2  | DV3  |       |       |
| 0   | 8       | 15   | 24   |       |       |
| <input type="checkbox"/> Light Index                  |         |      |      |       |       |
| <input type="checkbox"/> Diapause Index               |         |      |      |       |       |
| <input checked="" type="checkbox"/> Cold Stress       |         |      |      |       |       |
| TTCS  | THCS    | DTCS | DHCS | TTCSA | THCSA |
| -10   | -0.0001 | 0    | 0    | 0     | 0     |
| <input checked="" type="checkbox"/> Heat Stress       |         |      |      |       |       |
| TTHS  | THHS    | DTHS | DHHS |       |       |
| 24  | 0.003   | 0    | 0    |       |       |
| <input type="checkbox"/> Dry Stress                   |         |      |      |       |       |
| <input type="checkbox"/> Wet Stress                   |         |      |      |       |       |
| <input type="checkbox"/> Cold-Dry Stress              |         |      |      |       |       |
| <input type="checkbox"/> Cold-Wet Stress              |         |      |      |       |       |
| <input type="checkbox"/> Hot-Dry Stress               |         |      |      |       |       |
| <input type="checkbox"/> Hot-Wet Stress               |         |      |      |       |       |
| Day-degree accumulation above DV0                     |         |      |      |       |       |
| DV0   | DV3     | MTS  |      |       |       |
| 0   | 24      | 7    |      |       |       |
| Day-degree accumulation above DVCS                    |         |      |      |       |       |
| DVCS  | *DV4    | MTS  |      |       |       |
| 8   | 100     | 7    |      |       |       |
| Day-degree accumulation above DVHS                    |         |      |      |       |       |
| DVHS  | *DV4    | MTS  |      |       |       |
| 24  | 100     | 7    |      |       |       |
| Degree-days per Generation                            |         |      |      |       |       |
| PDD   |         |      |      |       |       |
| 0   |         |      |      |       |       |

## 2. Climatic prediction in the native range



The fitting parameters provide a distribution into North-America very close to the current distribution of the species (see appendix 2 for the distribution of the species in North America). The species is present in Alaska, and some localities are found in Northern California. The species could thrive in Eastern Canada but is not native to this area, most probably because its geographic distribution has been stopped by inappropriate climatic conditions in between Eastern and Western parts of North America. This climatic prediction fits quite well with the Canadian prediction.

### 3. Distribution for the world



The fitting parameters show that few areas in the world have suitable climatic conditions. Among these are:

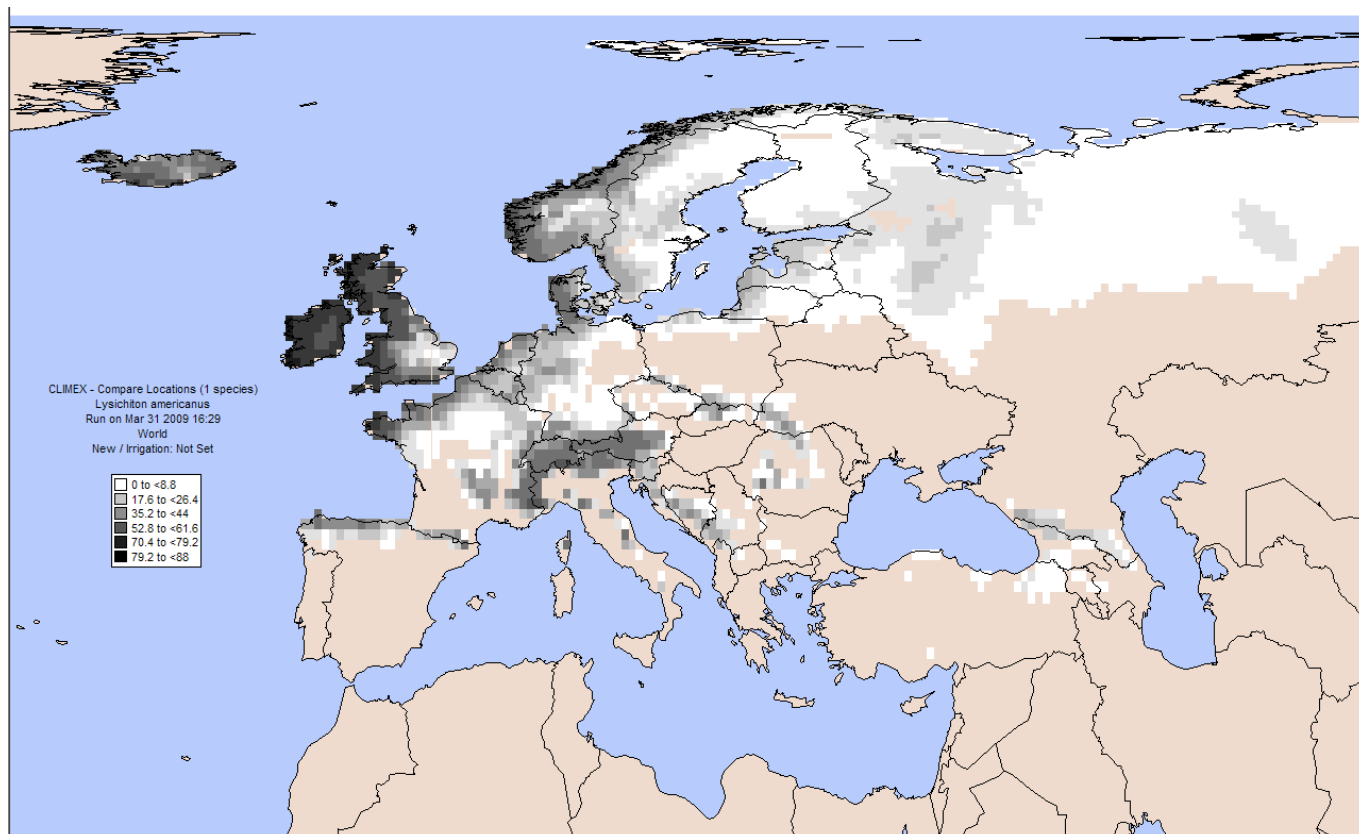
- the EPPO region (see detail below)
- New Zealand and Tasmania
- Himalaya in China, India, Pakistan, Tazikistan, Afghanistan, Kyrgyzstan
- In South America: Northern Andes in Ecuador and Columbia, Cordillera oriental and Occidental in Peru, southern Andes in Chile
- In Japan (Northern part), Sakhaline Island, Sichot Alien (Russia), Kamchatcka (Russia). To be noted that this corresponds to *Lysichiton camtschatcensis*' distribution.

#### 4. The EPPO region

The countries where the species is able to naturalize in the EPPO region are the following: Austria, Azerbaijan, Belarus, Belgium, Bosnia & Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Republic of Macedonia, Romania, Russia, Serbia, Slovenia, Spain (North), Sweden, Switzerland, Turkey (east coast of the Black Sea), Ukraine.

Areas particularly at risk being are areas having an Atlantic influence (the UK, Ireland, Northern coast of Spain, Bretagne in France, the Netherlands, Denmark, Norway), and mountainous areas (the Massif central in France, the Alps, the Pyrenees, the Carpatian Mountains, Bolsoj Kavkaz in Georgia, Ural Mountains in Russia).

The Mediterranean area is not considered at risk as it is assumed to be too warm and too dry during summer.



## References

Hickman J C eds (1993) *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley (US). [http://books.google.co.uk/books?id=sTR5\\_CQ-yAC&printsec=frontcover&dq=hickman,+1993,+lysichiton&source=gbs\\_summary\\_s&cad=0#PPA1104\\_M1](http://books.google.co.uk/books?id=sTR5_CQ-yAC&printsec=frontcover&dq=hickman,+1993,+lysichiton&source=gbs_summary_s&cad=0#PPA1104_M1)  
[http://www.coe.int/t/dg4/cultureheritage/conventions/Bern/T-PVS/sc24\\_inf04\\_en.pdf](http://www.coe.int/t/dg4/cultureheritage/conventions/Bern/T-PVS/sc24_inf04_en.pdf)

Natural Resources Canada Website

[http://planthardiness.gc.ca/ph\\_gcm.pl?lang=fr&speciesid=1002124](http://planthardiness.gc.ca/ph_gcm.pl?lang=fr&speciesid=1002124) Accessed in May 2009.

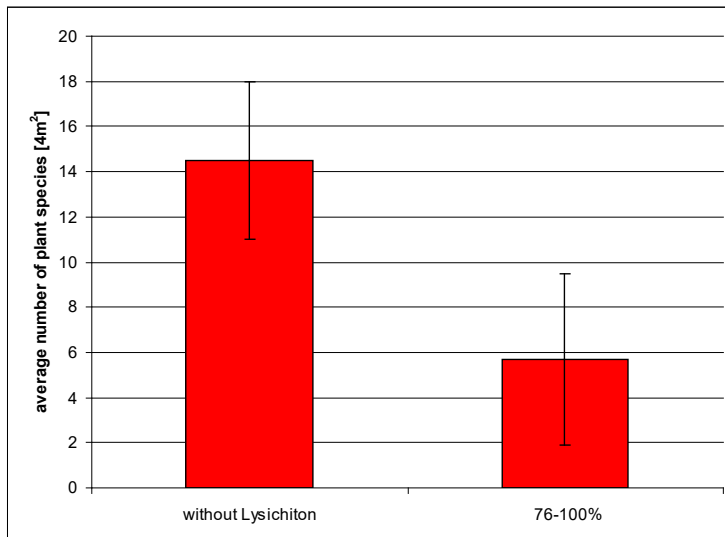


## Appendix 4

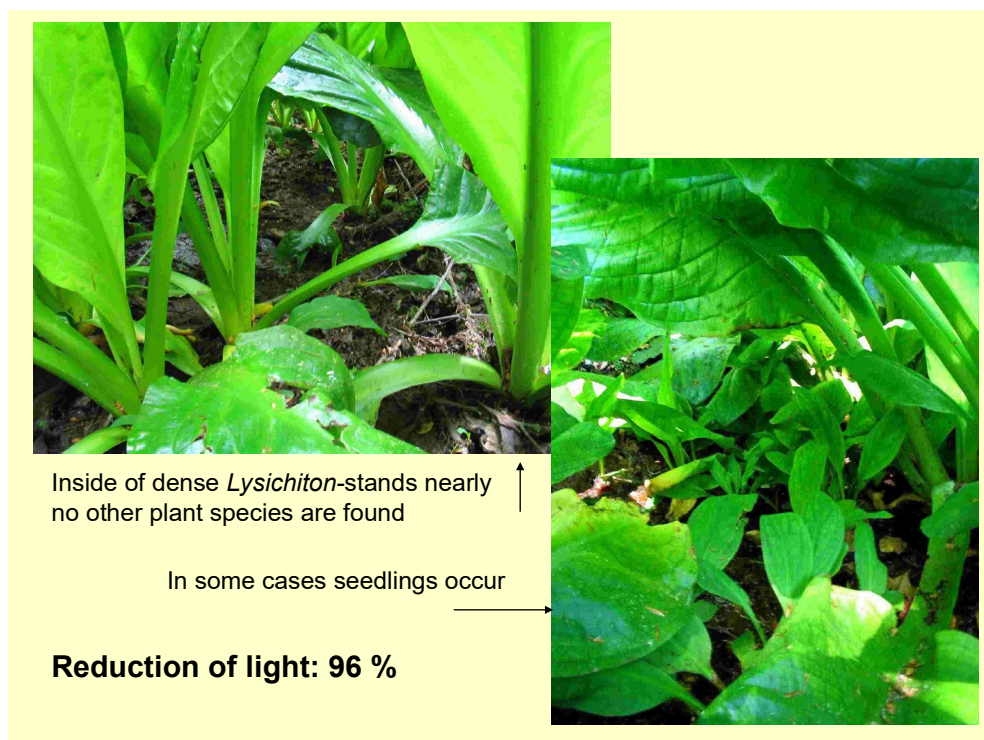
Impact of *Lysichiton americanus* in the Taunus

From B. Alberternst

## 1. Average number of species



Average number of plant species in relevées (4m<sup>2</sup>) without occurrence of *Lysichiton americanus* (n=40) and with *Lysichiton americanus* covering an area of 76-100% (unpubl. Data Alberternst). The number of plant species is significantly decreased in dense stands of *Lysichiton americanus*.



B. Alberternst

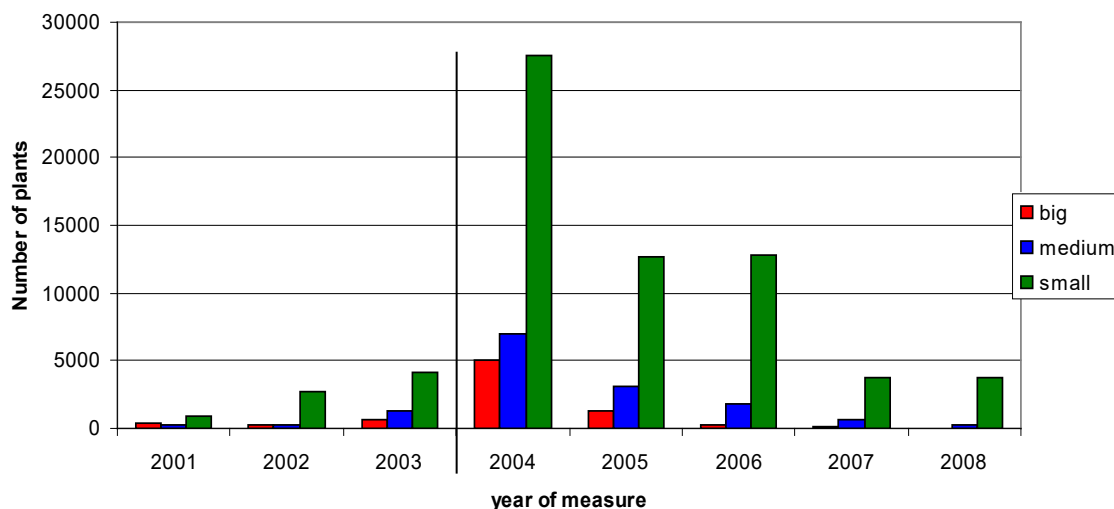
## 2. Endangered species

Endangered species and species which populations decrease at growing sites of *L. americanus* (Red List Mooses Germany, RL Farn- und Seedplants Hesse):

*Sphagnum teres* (RL D: 3)  
*S. subnitens* (RL D: 3)  
*S. russowii* (RL D: V)  
*S. inundatum* (RL D: V)  
*S. denticulatum* (RL D: V)  
*S. capillifolium* (RL D: V)  
*S. flexuosum* (RL D: V)  
*S. squarrosum* (RL D: V)  
*Hookeria lucens* (RL D: 3)  
*Leucobryum glaucum* (RL D: V)  
*Metzgeria furcata* (RL D: V)  
*Polytrichum commune* (RL D: V)  
*Scapania nemorea* (RL D: V)  
*Scapania undulata* (RL D: V)  
*Carex canescens* (RL He: 3)  
*Carex echinata* (RL He: V)  
*Carex demissa* (RL (NW) He: V)  
*Dactylorhiza majalis* (RL He: 3)  
*Dactylorhiza maculata* (RL He: 3)  
*Epilobium palustre* (RL He: V)  
*Menyanthes trifoliata* (RL He: 3)  
*Valeriana dioica* (RL He: V)  
*Viola palustris* (RL He: V)

## 2. Removal of *Lysichiton americanus* in the Taunus

Number of removed plants in Taunus 2001 to 2008



Test of appropriate measures

Digging up the plants in the whole area

Small: < 40 cm

medium: 40-80 cm

big: >80 cm leaf length

## Appendix 5

Nurseries which produce and/or sell *Lysichiton americanus* in France

| Name                           | Website  | Address   |
|--------------------------------|--|---|
| Lumen                          | <a href="http://www.lumen.fr/lumen//boutique/23410/lysichiton_americanus.htm">http://www.lumen.fr/lumen//boutique/23410/lysichiton_americanus.htm</a>  | Les Coutets - 24100 CREYSSE<br>Tél. : 05 53 57 62 15 - Fax. : 05 53 58 54 88  |
| Le Jardin du Pic-Vert          | <a href="http://www.jardindupicvert.com/4daction/w_partner/arum_bananier_jaune_lysichiton_americanus.427">http://www.jardindupicvert.com/4daction/w_partner/arum_bananier_jaune_lysichiton_americanus.427</a>                                | Le Jardin du Pic-Vert<br>SARL RCS Amiens 422 537 100<br>2 rue du Moulin<br>80110 - DOMART SUR LA LUCE<br>Tél : 03 22 46 69 86<br>Fax : 03 22 47 28 98<br>Email : <a href="mailto:jardin@jardindupicvert.com">jardin@jardindupicvert.com</a>   |
| Le jardin d'eau                | <a href="http://www.lejardindeau.com/prod/lysichiton-americanus-aqu-l4--30075.php?pro_id=112">http://www.lejardindeau.com/prod/lysichiton-americanus-aqu-l4--30075.php?pro_id=112</a>  | Le jardin d'eau - Les Biez - 22980 Saint-Michet-de-Plélan - 02 96 27 08 43  |
| Le CLOS du COUDRAY - PEPINIERE | <a href="http://pagesperso-orange.fr/leclosducoudray/secure.clos.paypal32.htm">http://pagesperso-orange.fr/leclosducoudray/secure.clos.paypal32.htm</a><br><br><a href="http://www.leclosducoudray.com/">http://www.leclosducoudray.com/</a> | Le CLOS du COUDRAY - PEPINIERE<br>76850 ETAIMPUIS - E.A.R.L. AU CAPITAL DE 13761 EUROS<br>RCS DIEPPE B 393 718 754 - code APE 911D - N° TVA FR 78 393 718 754<br>TELEPHONE : 02.35.34.96.85 - FAX : 02.35.34.52.57<br>email : <a href="mailto:plante@leclosducoudray.com">plante@leclosducoudray.com</a> web site: <a href="http://www.leclosducoudray.com">www.leclosducoudray.com</a> |
| CACTUS ESTEREL                 |  | Vincent CERUTTI<br>Chemin de Maupas<br><b>FR 83600 - BAGNOLS EN FORÊT</b><br><br>Tel. : 04 94 40 66 73 - Fax :04 94 40 69 11<br>E-mail : <a href="mailto:cactus.esterel@libertysurf.fr">cactus.esterel@libertysurf.fr</a><br>Site Web : <a href="http://www.aspeco.net/perso/cerutti.html">www.aspeco.net/perso/cerutti.html</a>  |
| Graines Baumaux                | <a href="http://www.graines-baumaux.fr/catalogue.php?cat=35&amp;sscat=313&amp;page=4">http://www.graines-baumaux.fr/catalogue.php?cat=35&amp;sscat=313&amp;page=4</a>  | Graines Baumaux - BP100 - 54062 Nancy Cedex<br>Email : <a href="mailto:contact@graines-baumaux.fr">contact@graines-baumaux.fr</a>   |
| La Pépinière aquatique         | <a href="http://www.lapepiniereaquatique.over-blog.com/article-6633670.html">http://www.lapepiniereaquatique.over-blog.com/article-6633670.html</a>  |   |
| Le Jardin français             | <a href="http://www.lejardinfrancais.fr/catalogue%20vivaces.pdf">http://www.lejardinfrancais.fr/catalogue%20vivaces.pdf</a>  | 24 rue René de Girardin 60950<br>ERMENONVILLE<br>Tel.+33 (3) 44 54 07 77 Fax.+33 (3) 44 54 03 58<br><a href="mailto:cdujols@hotmail.fr">cdujols@hotmail.fr</a>  |
|                                | <a href="http://cerdys.com/fr/produits/nos-plantes/recherche-multicriteres/bdd/p/5693/plante/faux-arum-d-amerique">http://cerdys.com/fr/produits/nos-plantes/recherche-multicriteres/bdd/p/5693/plante/faux-arum-d-amerique</a>              | Cerdys<br><br>Parc Tabari - Accès 3<br>BP 9337<br>44193 Clisson   |

|                                  |   |  |
|----------------------------------|---|--|
|                                  |   | Tél. 02 40 54 78 54<br>Fax. 02 40 54 27 46     |
| LA<br>NURSERY<br>D'ELISABET<br>H | <a href="http://dominique.desir.free.fr/NurseryElisabeth/Vivaces2005.html">http://dominique.desir.free.fr/<br/>NurseryElisabeth/Vivaces200<br/>5.html</a> | LA NURSERY D'ELISABETH tel : 01 39 56<br>16 96 |

Appendix 6

Pictures of stands of *Lysichiton americanus* in the Taunus



Regeneration of *L. americanus*. Picture: B. Alberternst



*Lysichiton americanus* at Robinienrondell, 2004-06-02. Picture: B. Alberternst