

Scientific name	<i>Azolla filiculoides</i>
Common name	Water fern
Broad group	Plant
Number of and countries wherein the species is currently established	19: BE, CZ, BG, DE, DK, GR, ES, FR, GR, HR, HU, IE, IT, NL, PL, PT, RO, SE, UK
Risk Assessment Method	GB NNRA
Links	<a href="https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=235">https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=235</a>
1. Description (Taxonomy, invasion history, distribution range (native and introduced), geographic scope, socio-economic benefits)	Socio-economic benefits: <i>Azolla filiculoides</i> is traded and imported for ornamental purposes (Brunel, 2009).
6. Can broadly assess environmental impact with respect to ecosystem services	The plant may affect provisioning, regulating and cultural services; it has been documented to interfere with irrigation systems (Hassan & Ricciardi, 2014). Dense mats reduce the quality of drinking water, increase siltation, reduce area available for recreation, clog irrigation pumps and reduce water flow in irrigation canals (Hill & Julien, 2004).
8. Includes status (threatened or protected) of species or habitat under threat	Not documented. Low impact in The Netherlands as it mainly thrives in degraded and eutrophicated habitats outside protected areas (Johan van Valkenburg personal communication).
9. Includes possible effects of climate change in the foreseeable future	Evidence from laboratory experiments indicates that Impact may rise. No change is predicted in Ireland (Kelly <i>et al.</i> , 2014). Present distribution may be linked to temperature, particularly the low temperature tolerance of the plant. The distribution extent of <i>A. filiculoides</i> could be expected to expand if climate changes were to influence temperatures, potentially making more sites suitable for colonisation. It should be noted that in many areas the populations of the plant fluctuate greatly year-on-year. It is thought that this is a consequence of the <i>Azolla</i> weevil <i>Stenopelmus</i>

	<p><i>rufinasus</i>, which is capable of causing local extinctions. It is difficult to predict how climate change might influence the relationship between the weed and the weevil.</p> <p><i>Azolla filiculoides</i> was shown to be able to survive sub-zero temperatures but died after 18 hours exposure to -4°C (Janes, 1998). The species optimum growth is achieved at 21-24°C (Van der Heide <i>et al.</i>, 2006). The range of the weed could be expected to expand if climate change were to influence the temperatures in the north of Europe, potentially making more sites available for colonisation. Biomass and C assimilation is significantly increased at elevated CO<sub>2</sub>, T and P concentrations, and that N-fixation was optimum at 21-29°C (Cheng <i>et al.</i>, 2010).</p>
11. Documents information sources	<p><b>Brunel S. 2009.</b> Pathway analysis: aquatic plants imported in 10 EPPO countries. <i>EPPO Bulletin</i> <b>39</b>: 201-213.</p> <p><b>Cheng W, Sakai H, Matsushima M, Yagi K, Hasegawa T. 2010.</b> Response of the floating aquatic fern <i>Azolla filiculoides</i> to elevated CO<sub>2</sub>, temperature, and phosphorus levels. <i>Hydrobiologia</i> <b>656</b>: 5-14.</p> <p><b>Hassan A, Ricciardi A. 2014.</b> Are non-native species more likely to become pests? Influence of biogeographic origin on the impacts of freshwater organisms 3. <i>Frontiers in Ecology and the Environment</i> <b>12</b>: 218-223.</p> <p><b>Hill MP, Julien MH. 2004.</b> The transfer of appropriate technology; key to the successful biological control of five aquatic weeds in Africa. XI International Symposium on Biological Control of Weeds, 370.</p> <p><b>Janes R. 1998.</b> Growth and survival of <i>Azolla filiculoides</i> in Britain I. Vegetative production. <i>New phytologist</i> <b>138</b>: 367-375.</p> <p><b>Kelly R, Leach K, Cameron A, Maggs CA, Reid N. 2014.</b> Combining global climate and regional landscape models to improve prediction of invasion risk. <i>Diversity and Distributions</i>.</p> <p><b>Van der Heide T, Roijackers RM, Van Nes EH, Peeters ET. 2006.</b> A simple equation for describing the temperature dependent growth of free-floating macrophytes. <i>Aquatic Botany</i> <b>84</b>: 171-175.</p>
Main experts	Johan van Valkenburg Etienne Branquart
Other contributing experts	Belinda Gallardo

Notes	<p>GBNNRA concludes high risk but the experts recommend the risk should be downgraded to medium because of fluctuating populations and impact level. It is noted that this species mostly colonizes eutrophicated areas. Furthermore the uncertainty is medium to high due to conflicting scientific information related to impact.</p> <p>Area at risk: Already colonized most of the European countries in the different bioregions (see q-bank and CABI ISC).</p>
Outcome	Compliant