FORMAT FOR A PRA RECORD (version 2 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		
			07-13387
	Guidelines on Pest Risk Analysis		P IAS Point 9.3
	Lignes directrices pour l'analyse du risque phytosanitaire		
	Decision-support scheme for quarantine pests Approved 2006-09 Version N°2		
PEST RISK ANALYSIS FOR *Polygonum perfoliatum* L.			
Pest risk analyst:			
EPPO Secretariat			
Stage 1: Initiation			

1 What is the reason for performing the PRA?		The plant is recorded as very invasive in the USA. The *ad hoc* Panel on invasive alien species recommended to study this species as it has a restricted distribution in the EPPO region.
2 Enter the name of the pest		*Polygonum perfoliatum* L.
2A Indicate the type of the pest		Plant
2B Indicate the taxonomic position		Polygonaceae
3 Clearly define the PRA area		EPPO Member countries.
4 Does a relevant earlier PRA exist?		A PRA exist for the USA (Lehtonen, 1994). A short assessment has been done for New-Zealand.
5 Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?		These PRAs are applied to different areas but some elements may still be valid.
Stage 2A: Pest Risk Assessment - Pest categorization		

6 Does the name you have given for the organism correspond to a single taxonomic entity which can be adequately distinguished from other entities of the same rank?	Yes	
8 Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?	Yes	The plant is considered a pest in the USA.
10 Does the pest occur in the PRA area?	Yes	The plant is indigenous to Siberia and has been detected in Turkey, but whether it is casual or naturalized there remains unknown.
12 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)?	Yes	In its alien range, *P. perfoliatum* invades a wide range of habitats, mainly open and disturbed ones. It is also found in undisturded areas such as stream banks, moist thickets, edges of pastures, edges of woods, early successional forests, abandoned fields, roadsides, railroad, nurseries, wood-piles, clearings and ditches in the U.S.A. It thrives where forests are clear-cut (Oliver, 1996).
13. 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 14)		No vector needed.
14 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)?	Yes	*P. perfoliatum* has a very wide native range and is considered a temperate species with subtropical tendencies and therefore has the potential to invade those portions of the contiguous United States that have the appropriate climate to provide a minimal eight week cold vernalization period. It is considered that its current geographical distribution in the USA only represents 20% of its possible range (Okay 1999). The ecoclimatic conditions of the current distribution are comparable with those of the PRA area for the pest to survive and thrive.
15 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) ?	Yes	This weed has a negative effect on forest regeneration and commercial forest areas (Christmas tree farms). *P. perfoliatum* is a threat to ecosystems as it has the ability to outgrow other species (Oliver, 1996).

16 This pest could present a risk to the PRA area.	Yes	The plant has an invasive behaviour in its alien range, having deleterious effects on cultivated (Christmas trees, forestry plantations) and wild plants. Climatic conditions are favourable and suitable habitats exist.
Section 2B: Pest Risk Assessment - Probability of introduction/spread and of potential economic consequences		
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.		The main pathway is unintentional introduction as a contaminant.
1.1 Consider all relevant pathways and list them		The main pathways are: - Unintentional introduction of seeds with plants for planting with growing media (e.g. *Rhododendron* stock, forestry trees). - Unintentional introduction with soil/growing media as a commodity: soil or growing media coming from Turkey, Belarus, Moldavia, Russia, Ukraine and third countries not belonging to continental Europe, other than Egypt, Israel, Libya, Morocco, Tunisia is prohibited of import in the EU. The pathway is not considered further. - *P. perfoliatum* is suspected to have been introduced with *Meliosma* seeds imported from China (Kumar and DiTommaso, 2005) or with *Ilex* (holly) seeds from Japan (Lehtonen, 1994). These statements are nevertheless only suppositions which cannot be confirmed and are not considered further in this analysis. Indeed, according to S Kurokawa (pers. com. 2007) there are no descriptions of *Ilex* seeds in the Trade Statistics of Japan, while generally, seed production of edible crops or horticultural crops including trees is a big market in Japan. Moreover, any seeds are inspected at the National Center for Seeds and Seedlings, based on IRST (International Rules for Seed Testing). - The first record of *P. perfoliatum* in North America is from Portland, Oregon (1890) where it was believed to arrive by ship ballasts (Stahl, 2002). This pathway is not considered further as no Plant Health regulation applies.

1.2 Estimate the number of relevant pathways, of different commodities, from different origins, to different end uses.	Few	There are about 25 countries where the plant is recorded, and at least one commodity (*Rhododendron* stock).
1.3. Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The following group of questions on pathways is then considered for each relevant pathway in turn, as appropriate, starting with the most important.		The main pathway is unintentional introduction of seeds with plants for planting with growing media from countries where *P. polygonum* occurs.
		Unintentional introduction of seeds with plants for planting with growing media from countries where *P. polygonum* occurs
1.4 How likely is the pest to be associated with the pathway at origin, taking into account factors like the prevalence of the pest at origin, the life stages of the pest, the period of the year?	Moderately likely	The plant has a negative impact on forest regeneration and commercial forest areas (Christmas tree farms) and is thought to have the potential to be a problem to nurseries orchards and the ornamental shrub industry that are not regularly tilled as a cultivation practice. Most nurseries in the mid-Atlantic U.S. are aware of *P. perfoliatum*, where it can be considered 'an emerging threat'. Its range is limited, thus most of the industry outside its range is unaware of this species and does not perceive it as widespread or serious. This weed is not common in container nurseries and may only become a concern in nurseries under very low management systems (one or less operation of maintenance per year), such as Christmas tree farms (R Bates, pers. com., 2007). Low management places of production are therefore likely to be invaded in the countries where the species occurs if these places are not tilled or chemically treated.
1.5 Is the concentration of the pest on the pathway at origin likely to be high, taking into account factors like cultivation practices, treatment of consignments	Unlikely for container industry, Moderately high for low management systems	The plant usually forms monospecific stands, and the production of seeds may be very concentrated. Nevertheless, the plant can be effectively controlled chemically using herbicides applied either preemergence or postemergence (McCormick and Hartwig, 1995), or with mowing or hand pulling.

1.6 How large is the volume of the movement along the pathway?	Moderately high	Data are only available in euros. (AIPH, 2005). Conifers from North-America and Asia are prohibited from import, they are therefore excluded from the analysis. Movement of ornamental horticultural products (excluding seeds): - 122 633 000 euros of plants were imported from Asia (excluding Middle east) to EU in 2004, 89 504 000 euros from North-America. - 78 000 euros of hardy perennials were imported in Europe from North-America, 246 000 euros from Asia (excluding Middle east) in 2004.
1.7 How frequent is the movement along the pathway?	Often	The movement is assumed to occur several times per week at the scale of the whole EPPO region.
1.8 How likely is the pest to survive during transport /storage?	Very likely	The seed will be transported in soil and remains viable many months.
1.9 How likely is the pest to multiply/increase in prevalence during transport /storage?	impossible	Seeds do not multiply.
1.10 How likely is the pest to survive or remain undetected during existing phytosanitary measures?	Very likely	The current requirements of the EU Plant Health Directive do not cover seeds in growing media, not even for bonsais. In Turkey, plants are only checked for nematodes. In Russia, introduction of plants with soil is restricted. Conifers originating from North-America and Asia are prohibited from import in the European Community. In EU, as *P. perfoliatum* is not considered a pest, phytosanitary measures would not apply and seeds of the pest may be present in plants for planting accompanied with growing media coming from Asia and from North-America.
1.11 How widely is the commodity to be distributed throughout the PRA area?	Very widely	Ornamental plants may be introduced in the whole EPPO region.
1.12 Do consignments arrive at a suitable time of year for pest establishment?	Yes	Seeds in growing media arrive at a suitable time for establishment since they can wait for suitable conditions for germination. Germination occurs in early to mid-March the following year and continuing through April (Kumar and DiTommaso, 2005).
1.13 How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	Very likely	Ornamental plants may be planted in gardens or on road sides and public places. Seeds of *P. perfoliatum* may germinate and produce other seeds. Those seeds may fall to the ground beneath parent plants, allowing local site dominance over time for this annual species (Van Clef, 2001). Birds and other animals (such as chipmunks, squirrel and deer) may be dispersal agents of *P.*

		perfoliatum (Okay, 1999) as the seed is not altered by the passage through the digestive gut (at least for birds). Water is also an important mode of long distance dispersal for *P. perfoliatum*. The long vines frequently hang over waterways, allowing fruits that detach to be carried away in the water current. Its fruits can remain buoyant for 7-9 days. During storm events the potential spread of this plant is greatly increased throughout watersheds (Okay, 1999). The drupes may also be spread by mowing equipment and shoes (Wikimanual of Gardening Website).
1.14 How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	Very likely	See previous answer. Ornamental plants and the growing media attached may be planted near streams, facilitating the spread of the plant.
1.15 Do other pathways need to be considered?	No	
1.16 a Specify the host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants) present in the PRA area.		It invades managed and unmanaged ecosystems: Cultivated ecosystems: open and disturbed ones such as abandoned fields, roadsides, railroad, nurseries, wood-piles, clearings and ditches, edges of pastures, edges of woods, pine plantations, early successional forests. Uncultivated ecosystems: freshwater ecosystems such as stream banks, moist thickets, etc. (Oliver, 1996).
1.16 b Estimate the number of host plant species or suitable habitats in the PRA area.	Many	Many cultivated ecosystems and freshwater ones.
1.17 How widely distributed are the host plants or suitable habitats in the PRA area? (specify)	Widely	These habitats are widely distributed.
1.18 If an alternate host is needed to complete the life cycle, how widespread are alternate host plants in the PRA area?		No alternate host needed.
1.19 Does the pest require other species for critical stages in its life cycle such as transmission, (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers) ?	No	It is primarily a self-pollinating plant (supported by its inconspicuous, closed flowers and lack of a detectable scent), with occasional outcrossing. Fruits and viable seeds are produced without assistance from pollinators. Birds and mammals are only one of the numerous way of spread.

1.19A Specify the area where host plants (for pests directly affecting plants) or suitable habitats (for non parasitic plants) are present (cf. QQ 1.16-1.19). This is the area for which the environment is to be assessed in this section. If this area is much smaller than the PRA area, this fact will be used in defining the endangered area.		Forests, freshwater habitats, nursery industries and managed sites are present throughout the EPPO region.
1.20 How similar are the climatic conditions that would affect pest establishment, in the PRA area and in the current area of distribution?	Similar	See Climex analysis below. The countries of Europe at risk are estimated to be: Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Croatia, France, Georgia, Germany, Italy, Montenegro, Poland, Portugal, Romania, Russia, Slovenia, Serbia, Spain, Switzerland, Turkey, Ukraine. Mediterranean countries (Morocco, Tunisia, Algeria, Israel, Lebanon, Jordan) are moderately likely to be at risk.
1.21 How similar are other abiotic factors that would affect pest establishment, in the PRA area and in the current area of distribution?	Very similar	*P. perfoliatum* generally grows in areas with an abundance of leaf litter on the soil surface (Okay, 1999), but has also been found in extremely wet environments with poor soil structure. Okay (1997) determined that a stratification period of at least 8 weeks at 5°C was required for breaking seed dormancy. At pH 3.5, however, stratification was not required, although germination levels were significantly lower (16.7%) than at pH 7.5 with cold treatment (46.7%) (Kumar and Di Tommaso, 2005). .
1.22 If protected cultivation is important in the PRA area, how often has the pest been recorded on crops in protected cultivation elsewhere?	Never	The plant has never been recorded in protected environments.
1.23 How likely is that establishment will not be prevented by competition from existing species in the PRA area?	Very likely	Lehtonen (1994) reports that the invasive *Lonicera japonica* has been displaced by *P. perfoliatum* and that *Sambucus canadensis* and *Rubus* spp. were overgrown and killed by the competition. *P. perfoliatum* is therefore extremely competitive.
1.24. How likely is that establishment will not be prevented by natural enemies already present in the PRA area?	Likely	Some biological control agents have been identified by the University of Delaware, but they originate from Asia, place of origin of the plant. It is therefore considered unlikely that existing species in the PRA area will prevent the establishment of the plant.
1.25 To what extent is the managed environment in the PRA area favourable for establishment?	Moderately favourable	Absence of practices in tree plantations would favour the establishment of the pest. Practices in nurseries (tillage, use of phytosanitary products) are not favourable. It is more likely to establish in a forest than in a nursery.

1.26. How likely is it that existing control or husbandry measures will fail to prevent establishment of the pest?	Moderately likely	If the invasion is taken at an early stage, the plant could be managed. Some management methods have been tested in North America.
1.27. How likely is it that the pest could survive eradication programmes in the PRA area?	Moderately likely	Lee *et al*. (2001) state that *P. perfoliatum* has been eradicated from Auckland (NZ). Ease of eradication is limited by the formation of a long term seed bank.
1.28 How likely is the reproductive strategy of the pest and the duration of its life cycle to aid establishment?	Very likely	*P. perfoliatum* is a very tender annual, overwintering as a seed. Germination occurs in early to mid-March the following year and continues through April (Kumar and DiTommaso, 2005). Until frost (late October to early November in regions of North eastern United States), the plant can grow up to 6 m long (15 cm per day), bearing about 50-100 seeds (Stahl, 2002). The plant reproduces only sexually. It is primarily a self-pollinating plant. The self-compatibility of this species contributes to its successful dispersal because single plants once established in a new habitat can produce new populations without the need for cross-pollination from neighbouring conspecies (Okay, 1997). The species may produce a small peak of production in July and a large peak of production of fruits from mid-September to November, which coincides with major bird migration. The species forms a long-term seed bank (Van Clef and Stiles, 2001). The ability of the plant seeds to germinate at relatively cold temperatures provides it a competitive advantage over other annual and perennial weeds that germinate at higher soil temperatures (Kumar and DiTommaso, 2005). The seeds are spread over long distances by water, birds and mammals. Van Clef (2001) found that seed longevity, seedling growth advantages provided by larger seeds and bird dispersal contribute most to increased invasiveness of the species in North America.
1.29 How likely are relatively small populations or populations of low genetic diversity to become established?	Likely	The introduction of *P. perfoliatum* in the late 1930's to a nursery site in York County (Pennsylvania) did produce a successful population of this plant. The distribution of *P. perfoliatum* has radiated from the York County site into neighbouring states.
1.30 How adaptable is the pest? Adaptability is:	High	The species can live in a wide range of habitats, and both in temperate and tropical climates. It has a wide native range of distribution.
1.31 How often has the pest been introduced into new areas outside its original area of distribution? (specify the instances, if possible)	Occasionally	It has been introduced in many states of North America, in New Zealand and in Turkey.

1.32 Even if permanent establishment of the pest is 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) ?		Permanent establishment is likely.
1.33 How likely is the pest to spread rapidly in the PRA area by natural means?	Likely	The plant has many ways of dispersal over long distances: water, birds, and mammals. It is an annual and would therefore form offsprings very fast (in 6 months).
1.34 How likely is the pest to spread rapidly in the PRA area by human assistance?	Moderately likely	The plant could be introduced in a nursery and be spread via nursery stocks quite rapidly. This has been the case for the spread of the plant across North America with rhododendron plants. In the past 55 years, the range of this plant in the United States has extended as far as about 500 km in several directions from the York County site (Mountain, 1995; Okay 1997).
1.35. How likely is it that the spread of the pest will not be contained within the PRA area?	Moderately likely	In a nursery or in a tree plantation, the plant could be contained easily if taken at an early stage. If escaped in unmanaged ecosystems, the plant would be difficult to control as it spreads via water courses and birds. Once introduced in the EPPO region, there are no barriers to its spread.
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.		Entry of the plant is moderately likely, although it is already present in Turkey. Establishment is likely. Its spread is likely, considering its biology and ecology.
1.36 Based on the answers to questions 1.16 to 1.35 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.		Open and disturbed ecosystems such as abandoned fields, roadsides, railroad, nurseries, wood-piles, clearings and ditches, edge of pastures, edges of wood, early successional forest and freshwater ecosystems such as stream banks, moist thickets are at risk in Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Croatia, France, Georgia, Germany, Italy, Montenegro, Poland, Portugal, Romania, Russia, Slovenia, Serbia, Spain, Switzerland, Turkey, Ukraine. Mediterranean countries (Morocco, Tunisia, Algeria, Israel, Lebanon, Jordan) are moderately likely to be at risk.
2.0 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.		
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?	Moderate	Because it can smother tree seedlings, this weed has a negative effect on forest regeneration and commercial forest areas (Christmas tree farms). It has the potential to be a problem to nursery and horticulture crops that are not regularly tilled as a cultivation practice. In revegetation areas of Virginia, additional costs for site preparation, weed management, and labor to replant tree saplings overtopped by this weed have been estimated to range from $60-500 per ha (Stanosz and Jackson 1991). At harvested sites in Pennsylvania, Mc Cormick and Hartwig (1995) observed mortality of regenerating tree saplings including *Pinus taeda* L. because of the dense canopy formed by this weed. Even if it has been observed growing on the edges of corn and soybean fields in Delaware (Lehtonen, 1994), it does not appear to be a threat in agricultural production likely because of continuous tillage and herbicide use (Kumar and DiTommaso, 2005).
2.2 How great a negative effect is the pest likely to have on crop yield and/or quality in the PRA area?	Moderate	The same economic impacts may be observed in the EPPO region.
2.3 How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area?	Moderate	Existing management practices (continuous tillage and herbicide use) for other pests may limit the negative effects of the plant. Nevertheless, in revegetation areas in Virginia, management included additional cost from $60-500 per ha (Stanosz and Jackson, 1991).
2.4 How great a reduction in consumer demand is the pest likely to cause in the PRA area?	None	
2.5 How important is environmental damage caused by the pest?	Major	*P. perfoliatum* weed is a threat to ecosystems as it has the ability to outgrow other species (Oliver, 1996). It is known to grow rapidly, scrambling over shrubs and other vegetation, blocking the foliage of covered plants from available light and reducing their ability to photosynthesize, which stresses and weakens them, the shade killing grasses and wildflowers. Okay (1997) observed decreases in native plant species diversity in areas colonized by *P. perfoliatum*. The American PRA (1994) reports that the plant can displace the invasive *Lonicera japonica*. Moreover, threatened freshwater ecosystems are already vulnerable and often protected. The species can also restrict the movement of wildlife in natural areas (Okay, 1997).

2.6 How important is the environmental damage likely to be in the PRA area (see note for question 2.5)?	Major	The same impacts are expected.
2.7 How important is social damage caused by the pest within its current area of distribution?	Minor	Dense thickets of the sharp-spined plants can provide an unpleasant experience for people (Binion, 2005).
2.8 How important is the social damage likely to be in the PRA area?	Minor	Impacts are not thought to be superior than in other invaded places.
2.9 How likely is the presence of the pest in the PRA area to cause losses in export markets?	Minor	The plant can be seen as a contaminant of ornamental plants and be regulated as such.
2.9A As noted in the introduction to section 2, the evaluation of the following questions may not be necessary if any of the responses to questions 2.2, 2.3, 2.4, 2.6 or 2.8 is "major or massive" or "likely or very likely". In view of these responses, is a detailed study of impacts required?	No	Environmental damage could be major.
2.10. How easily can the pest be controlled in the PRA area?	Easily to difficult	It is only recorded in Turkey and could therefore be controlled and maybe eradicated there, depending on the situation in this country. If no action would be taken and that the plant was to be spread and introduced into many countries, it would be very difficult to manage.
2.11. How likely is it that natural enemies, already present in the PRA area, will not suppress populations of the pest if introduced?	Likely	Other *Polygonum* sp. exist in Europe, though, the plant was not suppressed by natural ennemies in North America when it has been introduced.
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?	Very likely	As the plant smothers other species and outgrows trees, cuttings would imply to create gaps and openings in vegetation, leading to negative impacts on the environment. The use of herbicides would also have adverse effects on environment, even more in vulnerable freshwater ecosystems.
2.13. How important would other costs resulting from introduction be?	Moderate	Other costs from introduction imply: Information for nursery growers to recognize and suppress the plant. Costs of monitoring and surveillance.
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?	Unlikely	No hybridization has been noted with indigenous North American *Polygonum* spp.

2.15A Do you wish to consider the questions 2.1 to 2.15 again for further hosts/habitats?	No	
2.16 Referring back to the conclusion on endangered area (1.36), identify the parts of the PRA area where the pest can establish and which are economically most at risk.		Nurseries, tree plantations and freshwater ecosystems of Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Croatia, France, Georgia, Germany, Italy, Montenegro, Poland, Portugal, Romania, Russia, Slovenia, Serbia, Spain, Switzerland, Turkey, Ukraine. Mediterranean countries (Morocco, Tunisia, Algeria, Israel, Lebanon, Jordan) are moderately likely to be at risk.
2.16A 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 the areas of uncertainty 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. 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.	Medium	Uncertainty: - It would be very helpful to know by which pathway the plant arrived in Turkey and what is the situation there. - Information on the eradication in Auckland may give helpful information on the ease to control the pest at an early stage. - The climatic prediction has not been run for Mediterranean countries.
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.	Low	Unintentional introduction of seeds with plants for planting with growing media from countries where *P. polygonum* occurs: unlikely to moderately likely The probability of a contaminated consignment arriving is not extremely high, nevertheless, the plant occurs in Turkey and maybe in other places where it has not been recorded.
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	High	Once entered, the plant has a very high probability to establish and to spread.

establishment.		
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.	Medium	The plant may be a threat in tree plantations and nurseries of the countries at risk. The main impacts would be on environment, especially on freshwater ecosystems.
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 pest risk associated.		The plant qualifies as a quarantine pest, it represents a risk and measures should be considered.

This is the end of the Pest risk assessment	

Stage 3: Pest risk Management

3.1. Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combination an acceptable risk?	No	
Pathway 1		Unintentional introduction of seeds with plants for planting with growing media from countries where *P. polygonum* occurs
3.2. Is the pathway that is being considered a commodity of plants and plant products?	Yes	
3.10. Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest	No	General measures for plants for planting with growing medium attached from non-European countries exist in the EU but are not specific enough to prevent the introduction of *P. perfoliatum.* In the EU regulation, measures for bonzais fulfill the requirements for pest free place of production.
3.11. Can the pest be reliably detected by a visual inspection of a consignment at the time of export during transport/storage or at import?	No	Seeds are no more than 2 mm in diameter and will be mixed with soil.
3.12. Can the pest be reliably detected by testing (e.g. for pest plant, seeds in a consignment)?	No	Not relevant.
3.13. Can the pest be reliably detected during post-entry quarantine?	No	Not reliable. The seed may remain dormant for many years.
3.14. Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?	No	Any treatment could also have an effect on the consignment imported.
3.15. Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants)	Yes	The plant only occurs in the soil. Freedom of growing media would prevent the entry of the plant. Nevertheless, it is not possible to remove the growing media on some large plants without greatly reducing their probability of survival.

3.16. Can infestation of the consignment be reliably prevented by handling and packing methods?	No	Not relevant.
3.17. Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?	No	The seeds can germinate after months; limited periods of entry are therefore not relevant. The only end use of the consignement is planting.
3.18. Can infestation of the commodity be reliably prevented by treatment of the crop?	No	Some mechanical and chemical management methods exist. Nevertheless, the plant produces many little seeds (2 mm in diameter) that can remain viable a few years (3 years).
3.19. Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants)	No	Not relevant.
3.20. Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water...)?	Yes	If plants are grown in containers with sterilized growing medium.
3.21. Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?	No	Seeds may be contained in the growing media all year long from previous generations.
3.22. Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?	No	Not relevant.
3.23. Is the pest of very low capacity for natural spread?	No	
3.24. Is the pest of low to medium capacity for natural spread?	Yes	Pest-free place of production, Or pest-free place of production and appropriate buffer zone, Or pest free area.
3.27. Can pest freedom of the crop, place of production or an area be reliably guaranteed?	Yes	

3.28. Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts?	Yes	- In the importing countries, surveillance of nurseries, tree plantations and vulnerable freshwater ecosystems could detect the plant as it has identifiable characters. Eradication should ideally be done before the plant reaches natural habitats in which surveillance and eradication may prove very difficult. Information to be added on the eradication in New Zealand. - In the exporting countries, plants could be grown in containers with sterilized growing media.
3.29. Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest?	Yes	Pest-free place of production, Or pest-free place of production and appropriate buffer zone, Or pest-free area, Or plants grown in containers with sterilized growing media, Or plants free from growing media, Or surveillance and eradication.
3.30. Taking each of the measures identified individually, does any measure on its own reduce the risk to an acceptable level?	Yes	Pest-free place of production, Or pest-free place of production and appropriate buffer zone, Or pest-free area, Or plants grown in containers with sterilized growing media, Or plants free from growing media.
3.31. For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?	No	
3.33. Estimate to what extent the measures (or combination of measures) being considered interfere with trade.		Since requiring place of production freedom is a common measure for Plants for Planting, this should not interfere too much with trade. The requirement for freedom of soil is already common practice but not in the EU countries so this could have an impact on trade.
3.34. Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.		Difficult to estimate, but the plant may prove very difficult and costly to manage.
3.35. Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?	Yes	Pest-free place of production, Or pest-free area, Or plants grown in containers with sterilized growing medium, Or pest-free place of production and appropriate buffer zone (as the plant may be spread by waters and birds), Or plants free from growing media,

3.36. Envisage prohibiting the pathway	No	
3.37. Have all major pathways been analyzed (for a pest-initiated analysis)?	Yes	
3.38. Have all the pests been analyzed (for a pathway-initiated analysis)?	Yes	
3.39. For a pathway-initiated analysis, compare the measures appropriate for all the pests identified for the pathway that would qualify as quarantine pests, and select only those that provide phytosanitary security against all the pests.		Unintentional introduction of seeds with plants for planting with growing media from countries where *P. polygonum* occurs: Pest-free place of production Or pest-free place of production and appropriate buffer zone (as the plant may be spread by waters and birds), Or pest-free area Or plants grown in containers with sterilized growfing medium Or plants free from growing media. Measures with a very low level of protection: Monitoring and surveillance in the importing country and emergency plan to eradicate the outbreaks.
3.40. Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment		Unintentional introduction of seeds with plants for planting with growing media from countries where *P. polygonum* occurs: higher pathway.
3.41. All the measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners.		
3.42. In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed (see EPPO Standard PM 1/1(2): Use of phytosanitary certificates)		

3.43. If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade (e.g. prohibition), are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented.		
Conclusion of Pest Risk Management. **Summarize the conclusions of the Pest Risk Management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.**		Unintentional introduction of seeds with plants for planting with growing media from countries where *P. polygonum* occurs: Pest-free place of production, Or pest-free area, Or plants grown in containers with sterilized growing medium, Or plants free from growing media. This solution implies international regulation and consequences on trade. Another very efficient option will be to prohibit plants with growing media from outside the EPPO region as growing media can carry many other pests than this one. Measures with a lower level of protection: Monitoring and surveillance in the importing country and emergency plan to eradicate the outbreaks. Monitoring and surveillance is not already in place in country. This lower level of protection may prove insufficient.

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***Polygonum perfoliatum* (Polygonaceae) climatic prediction with CLIMEX**

The example below describes the preliminary approach used for the mile a minute weed (*Polygonum perfoliatum*). Further work can still be undertaken, e.g. using sensitivity analysis, to provide greater confidence in the reliability of the results.

Polygonum perfoliatum (Polygonaceae) is native to Asia and invasive in America. It has been selected for CLIMEX analysis as it was considered to be absent from the EPPO region (for more information on the EPPO region: www.eppo.org). However, the EPPO region is very large, has a wide variety of bio-climatic regions and numerous protected habitats, so absence is often difficult to prove. In fact, after investigations, it was found that the plant is indigenous in Siberia and exotic (naturalized or casual) in Turkey.

Moreover, this plant is difficult to study since precise information on its distribution in Asia is unavailable

1. Preliminary work and hypothesis

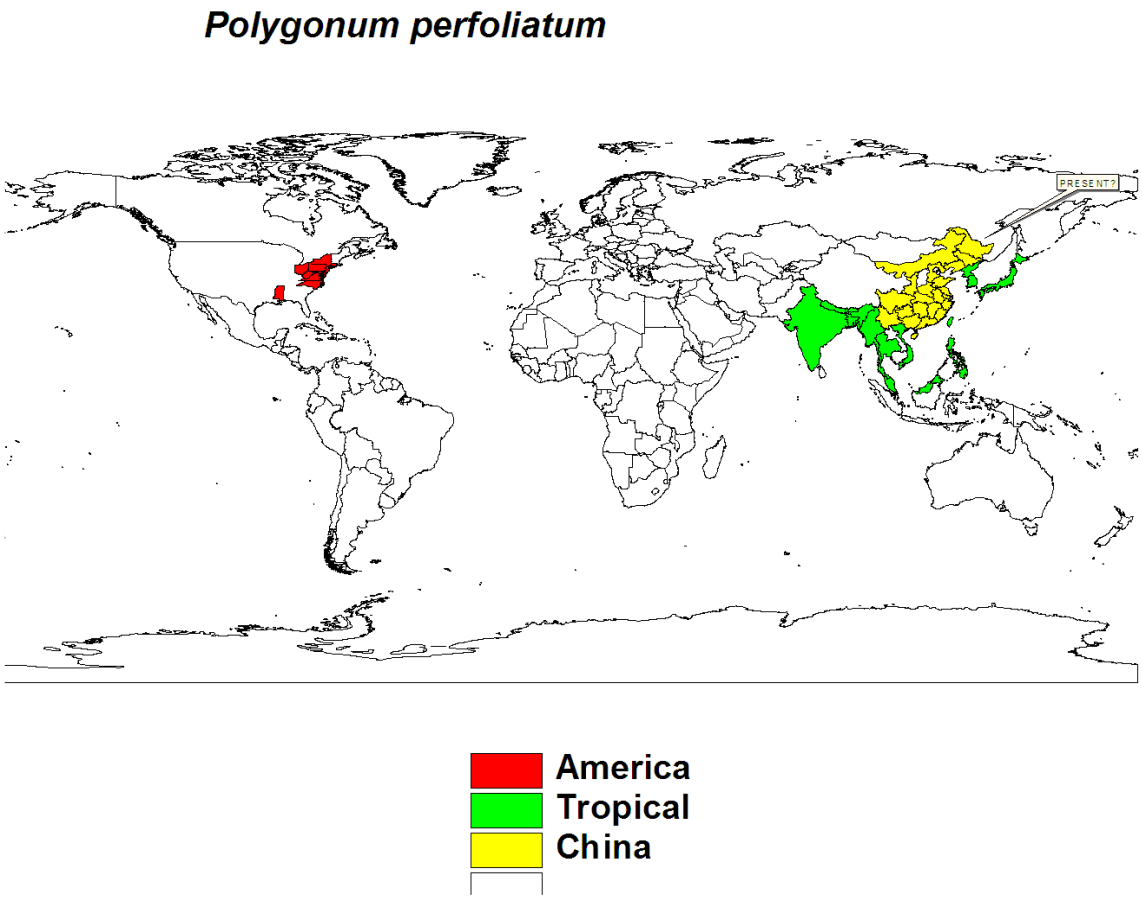

Fig 1: **Geographical distribution** of the plant in the world, differentiating native and alien range. The map has been made with Arcview.

According to this map and to information gathered in the bibliography on the **biology** of the plant, the following **hypotheses** on limitation factors and potential stresses can be made:

- The plant is considered to be temperate and to be able to colonize subtropical climates. The temperate template will be used for the Compare location analysis.

- The plant is an annual, with a maximum height of 6 m and reproduces successfully until it senesces after the first frost in late October to early November (in regions of eastern North America). Germination occurs in early to mid-March the following year and continues throughout April. The seeds lie dormant in the soil

and can survive very harsh winters. This implies that only the climate between April and November is important for the plant. While conducting a Match climate analysis, this needs to be taken into account. Cold winters are not a limiting factor and winter conditions should be excluded (though vernalisation requirements may need to be taken into account). While conducting a Compare location analysis, the cold stress would be reduced.

- The plant can be found below 2300 m in moist areas in its native range, confirming that the plant does not seem to be limited by cold summers as temperatures at such elevations are low.

- *Polygonum perfoliatum* grows in wet habitats. It is therefore not limited by wet stress. While conducting a Compare location analysis, wet stress can therefore be reduced. Although the plant can survive in areas with relatively low soil moisture, it demonstrates a preference for high soil moisture. Soil moisture is necessary and may therefore need to be increased.

- It is stated that a temperature of 10°C or below must be sustained for an eight-week period to stimulate germination. Heat stress may therefore need to be increased.

- from the Asian distribution, cold winters and hot and wet summers do not seem to be limiting factors. For the Compare location analysis, dry stress is therefore considered as the main limiting factor.

2. Match index

We have few details of locations where *P. perfoliatum* is very abundant in Asia and North-Eastern USA (Fig. 1) to use the CLIMEX Match Index to identify European locations that would be most suitable for this species. Pittsburgh (USA) and Taipei (Taiwan) were chosen to represent locations where the species is known to be abundant and a Composite Match Index for all variables between April and October at 10 minutes latitude/longitude resolution for Europe was calculated and mapped in each case (Figs. 2 & 3).

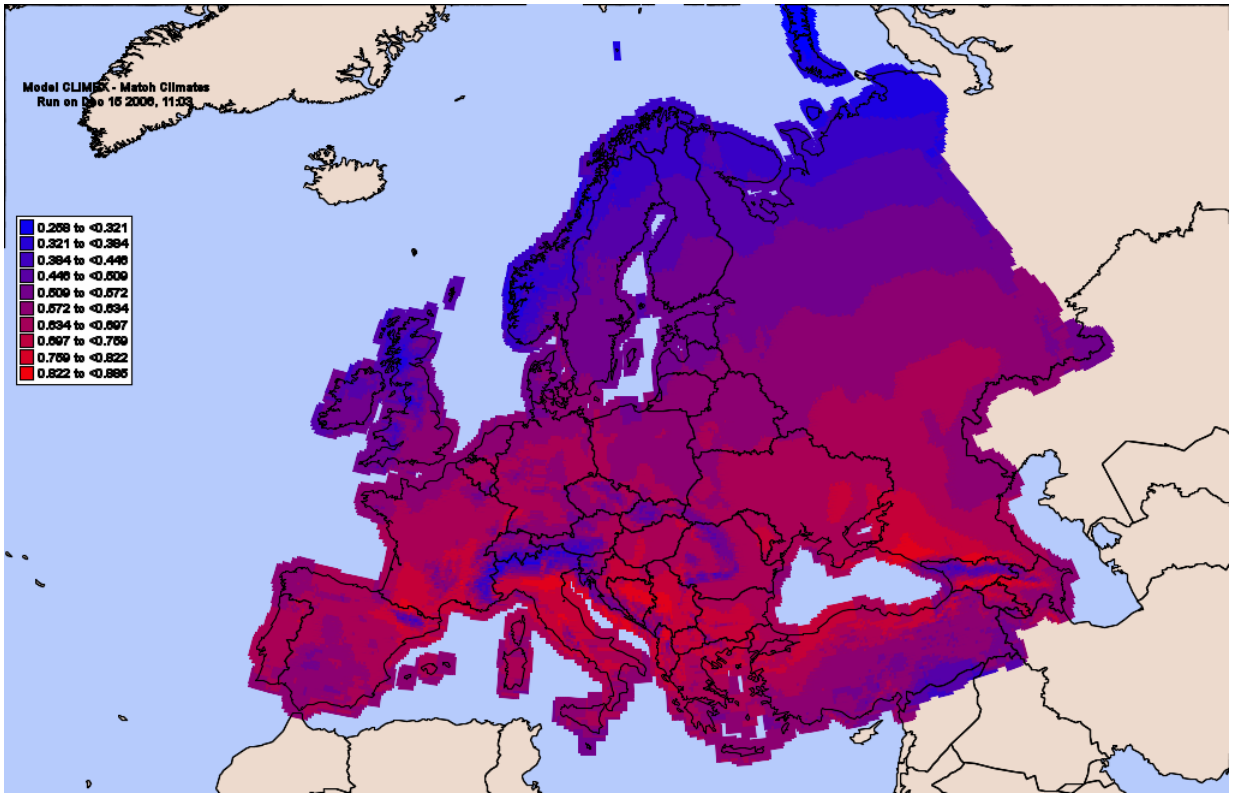

Fig. 2: CLIMEX Match Index: Comparison of Pittsburgh, USA, with Europe, 10 minute resolution

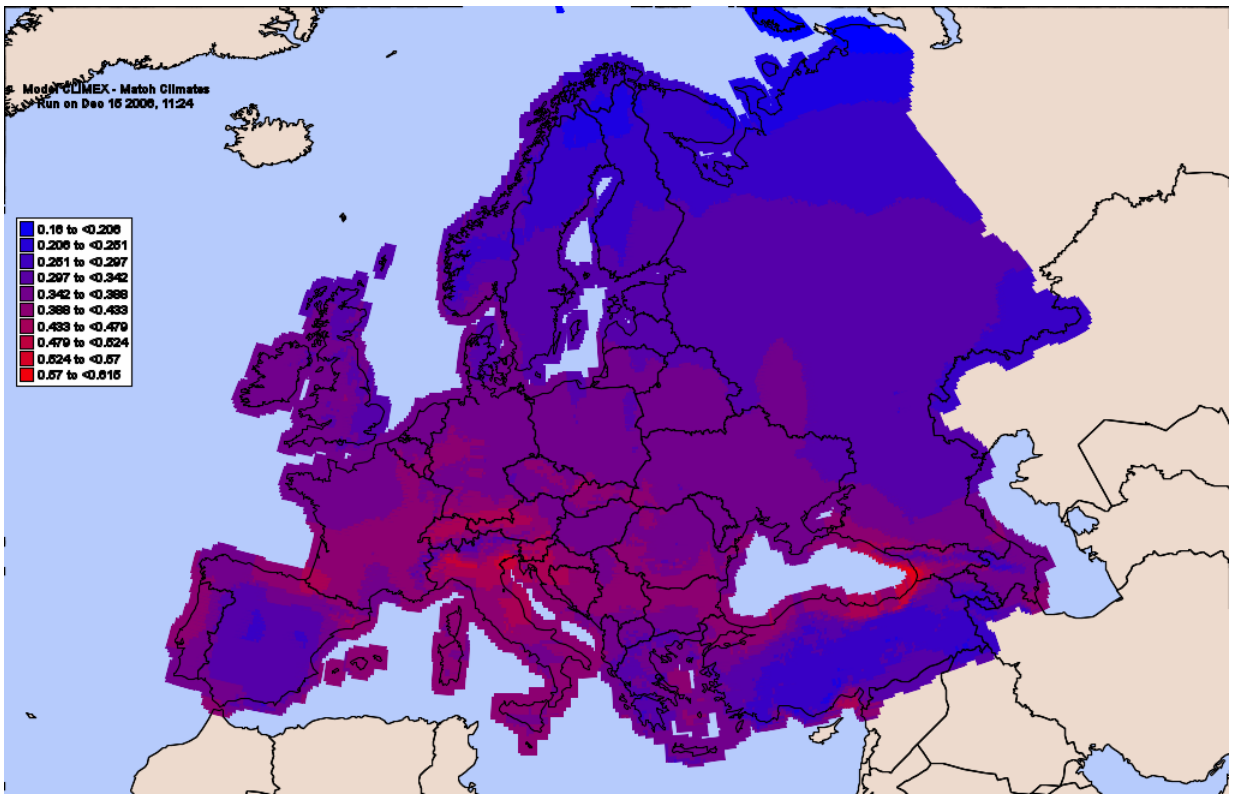

Fig. 3: CLIMEX Match Index: Comparison of Taipei, Taiwan, with Europe, 10 minute resolution

3. Compare Locations

The native range of *P. perfoliatum* is in Asia, particularly China, and it has invaded North-Eastern USA. CLIMEX Compare locations parameters were first developed by trial and error for Asia, tested in the USA, and then applied to Europe and then to the world.

For *P. perfoliatum*, the temperate template was used (Fig. 4).

3.a. Setting of the parameter by trial and error for Asia

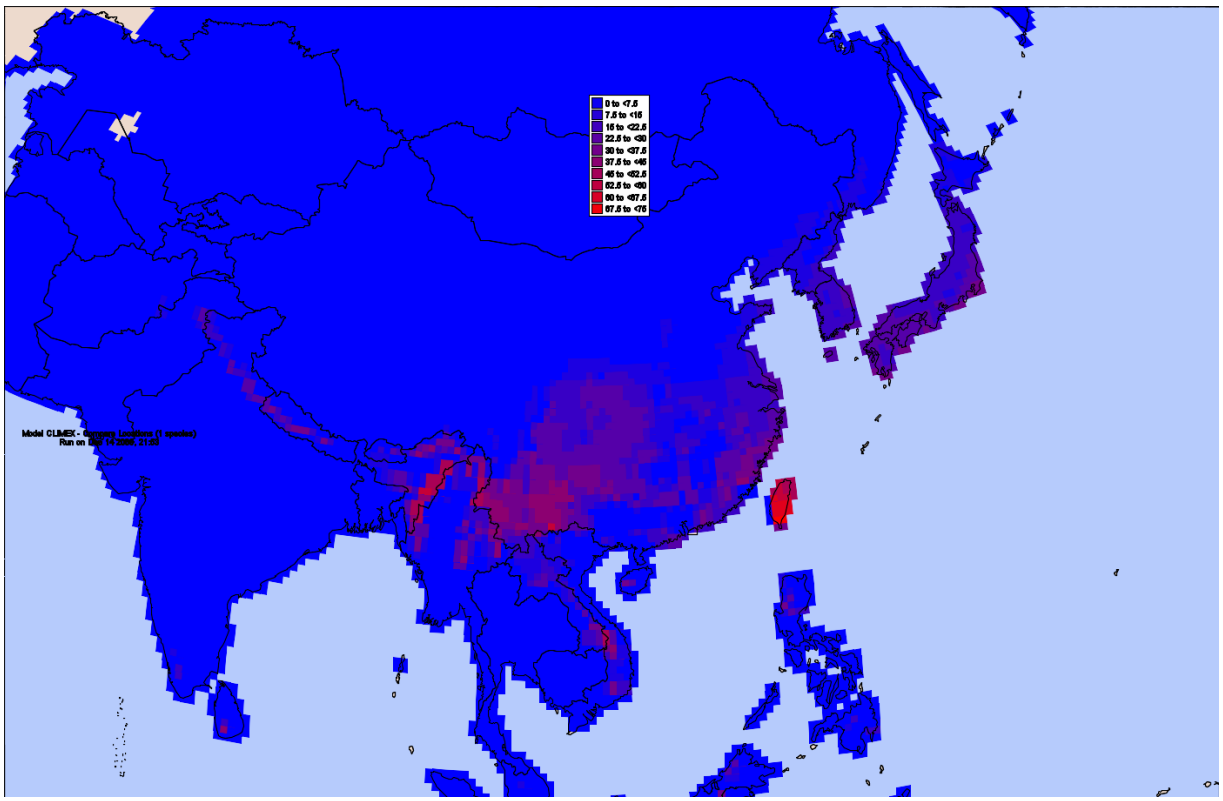

Fig. 4: CLIMEX Ecoclimatic Indices for the Temperate Template in Asia

First parameter assessed: cold stress

The cold stress degree-day threshold was reduced from 15 (value given in the temperate template) to 0 reflecting the knowledge that this species is an annual that can survive very extreme winter temperatures. This provides a distribution of ecoclimatic indices (EIs) (Fig. 5) that does go as far north as the species has been recorded in China and eastern Russia but does not go sufficiently far south in Asia, e.g. to the Philippines and Malaysia.

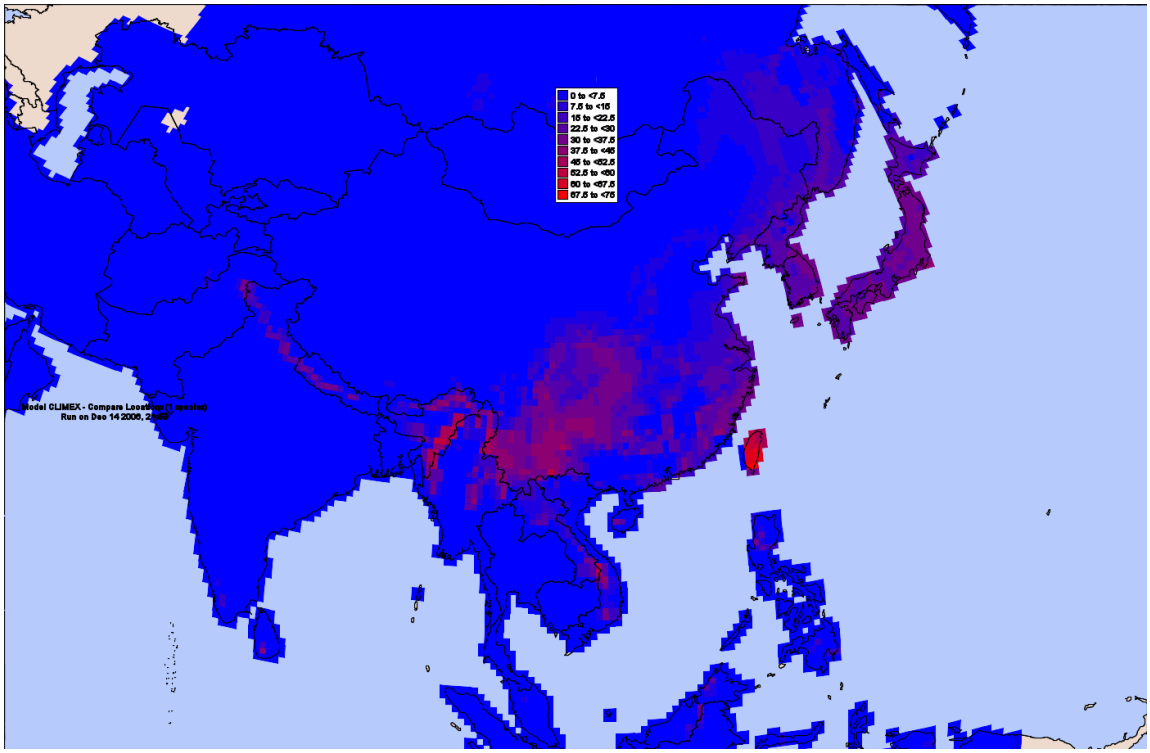

Fig. 5: *CLIMEX* Ecoclimatic Indices for the Temperate Template, no cold stress (cold stress=0 instead of 15).

Second parameter: wet stress

P. perfoliatum is not limited by wet stress. However, changing the wet stress to zero (instead of 2.5) had very little effect on distribution.

Third parameter: soil moisture
Increasing the soil moisture minimum to 0.35 (instead of 0.25) had also very little effect on the species distribution.

Fourth parameter: heat stress
To ensure the distribution includes the Philippines and Malaysia, the temperature at which heat stress accumulates was raised to 36ºC (instead of 30°C), as in the wet tropical template. This gives a distribution approximately similar to that occurring in Asia (Fig. 6).

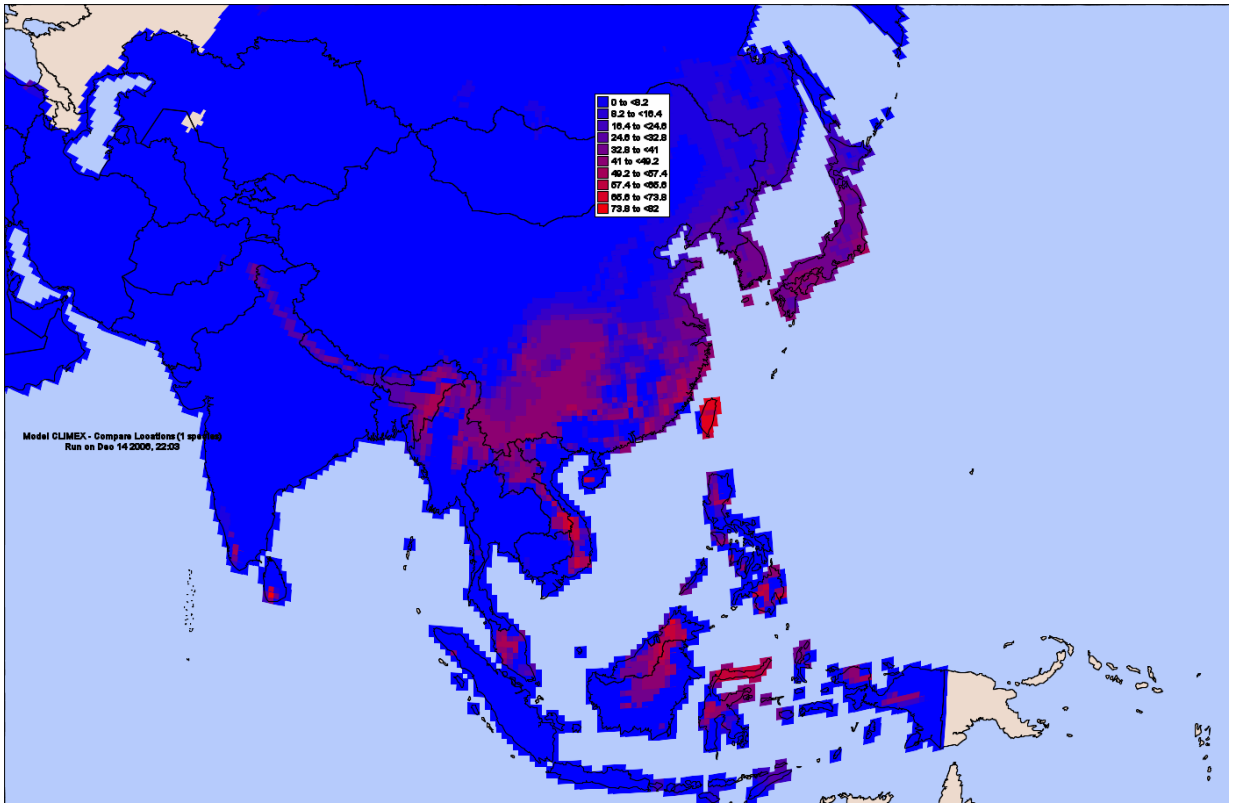

Fig. 6: CLIMEX Ecoclimatic Indices for the Temperate Template, no cold stress, no wet stress, soil moisture minimum to 0.35, maximum temperature 36ºC.

Fifth parameter: DV1
It is known that cool weather during the summer can limit growth and development. Although, the number of degree-days needed to complete development is unknown, there is only one generation and, in North-Eastern USA, this is completed in late autumn. To reflect the importance of summer warmth to complete development, the minimum threshold of development was increased from 8º to 12ºC while keeping the number of degree-days to the temperate template limit of 600.

The map (Fig. 7) now appears to emulate the distribution of *P. perfoliatum* in Asia.

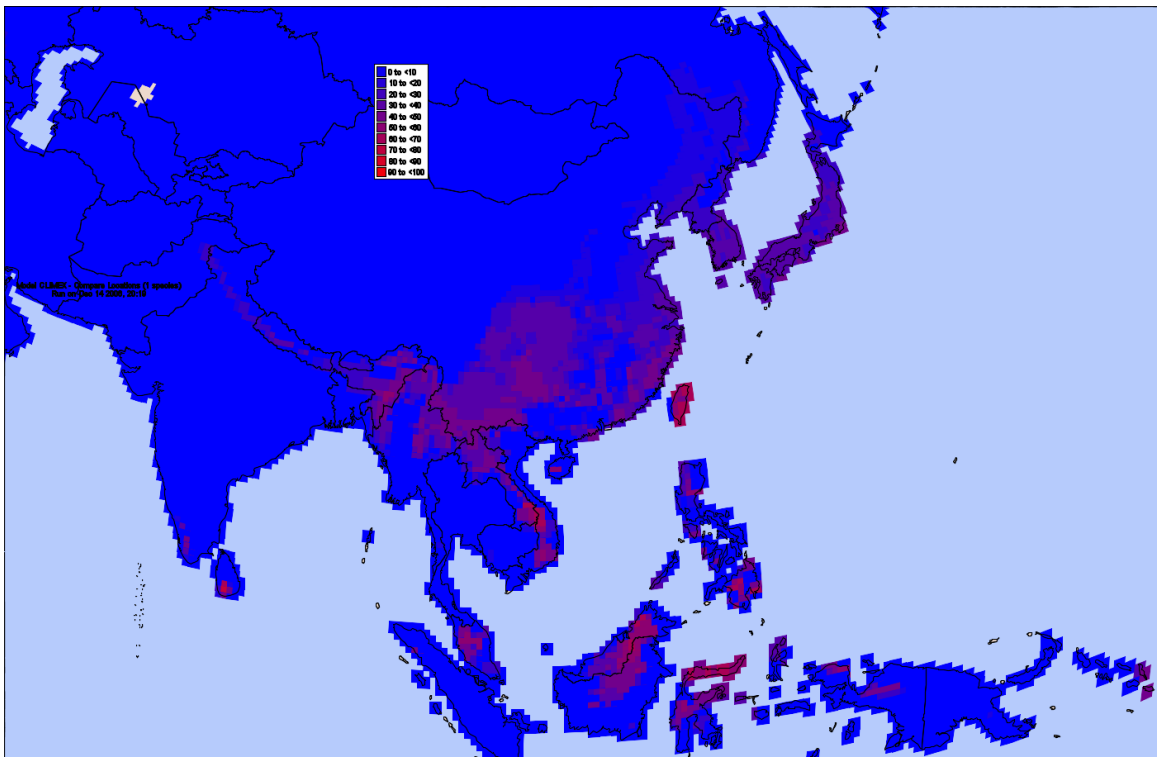

Fig. 7: *Polygonum perfoliatum* Ecoclimatic Indices for South-Eastern Asia (Temperate Template, no cold stress, no wet stress, soil moisture minimum to 0.35, maximum temperature 36ºC, DV1=12°C).

Importation of the data into GIS

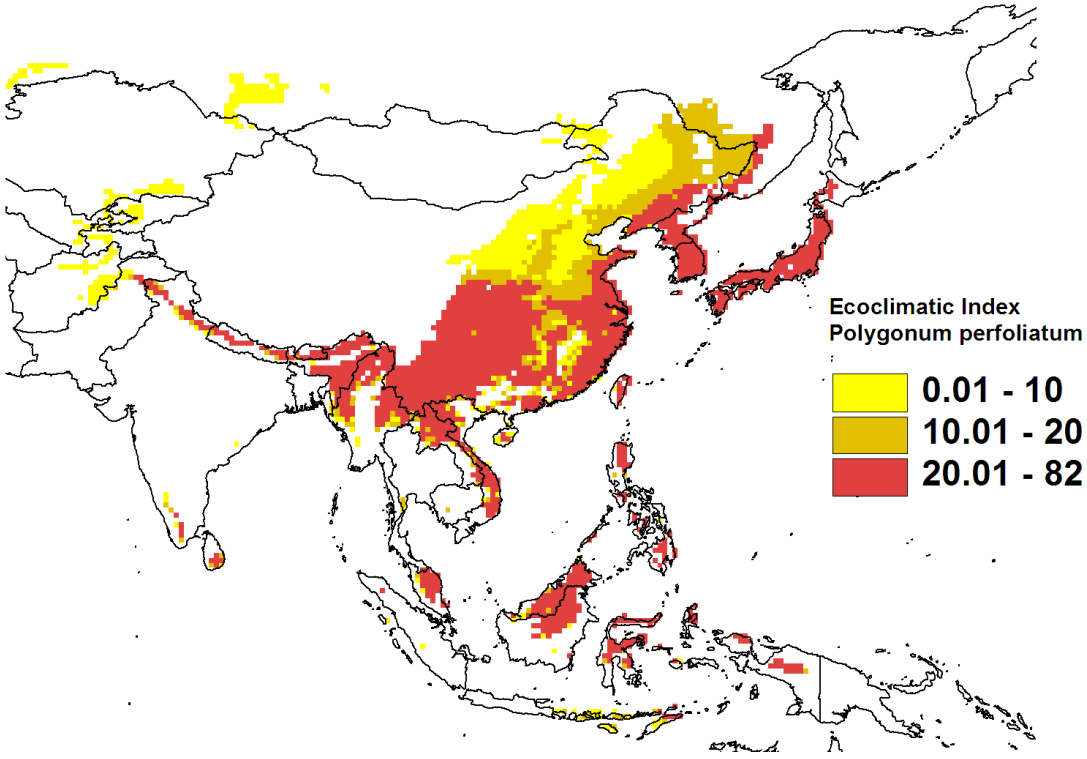

Fig. 8: *Polygonum perfoliatum* Ecoclimatic Indices for South-Eastern Asia imported to ArcGIS.

3.b Testing of the parameters in the USA

While making a prediction map for the USA with the parameters previously set, it appears that it is also similar to the distribution of the pest in the USA (Fig. 9). It is interesting to note that the species has been recorded in North-Western USA (Washington State) but died out and that this CLIMEX analysis also identified a few locations with

EIs greater than zero in the same area. In most places, however, EIs were zero due to insufficient degree-day accumulation.

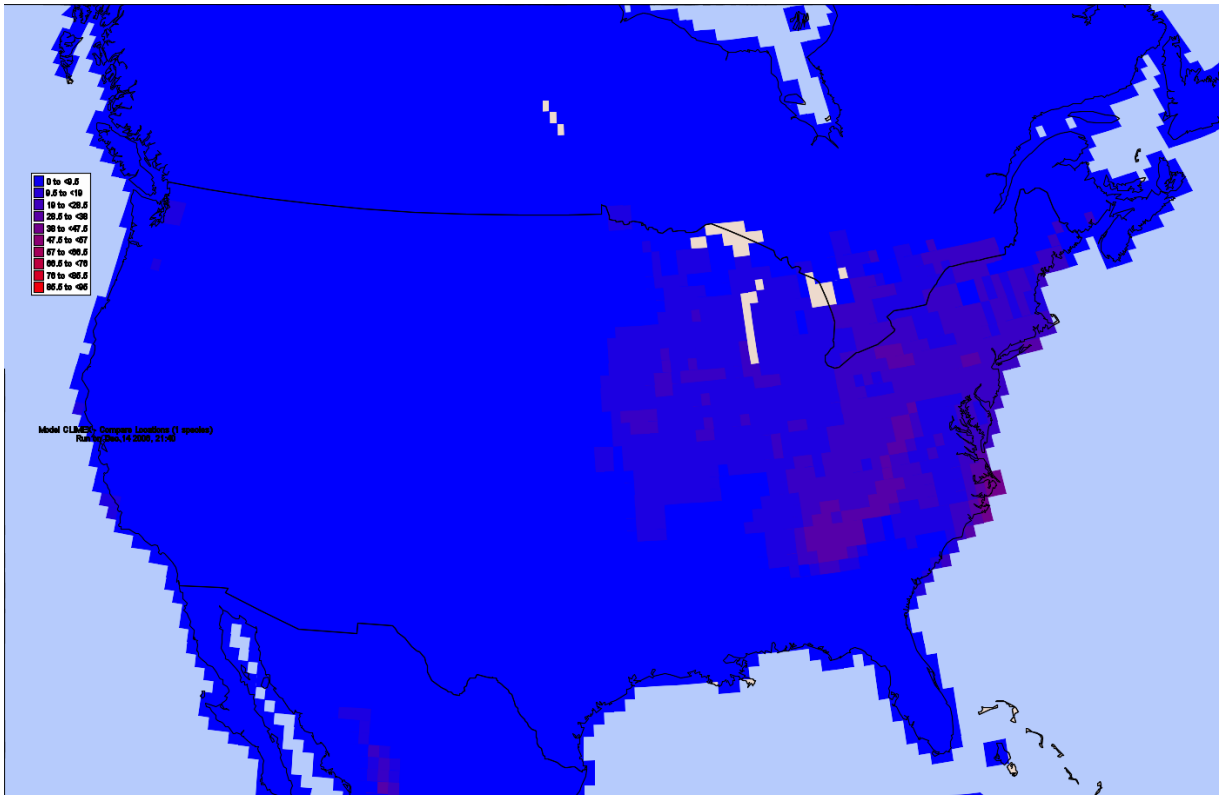

Fig. 9: *Polygonum perfoliatum* Ecoclimatic Indices for North America (Temperate Template, no cold stress, no wet stress, soil moisture minimum to 0.35, maximum temperature 36ºC, DV1=12°C)

3.c Climatic prediction for Europe and the world

The similarity of the CLIMEX predictions for the USA and the known distribution gives some credence to the map of potential distribution for the world (Fig. 10).

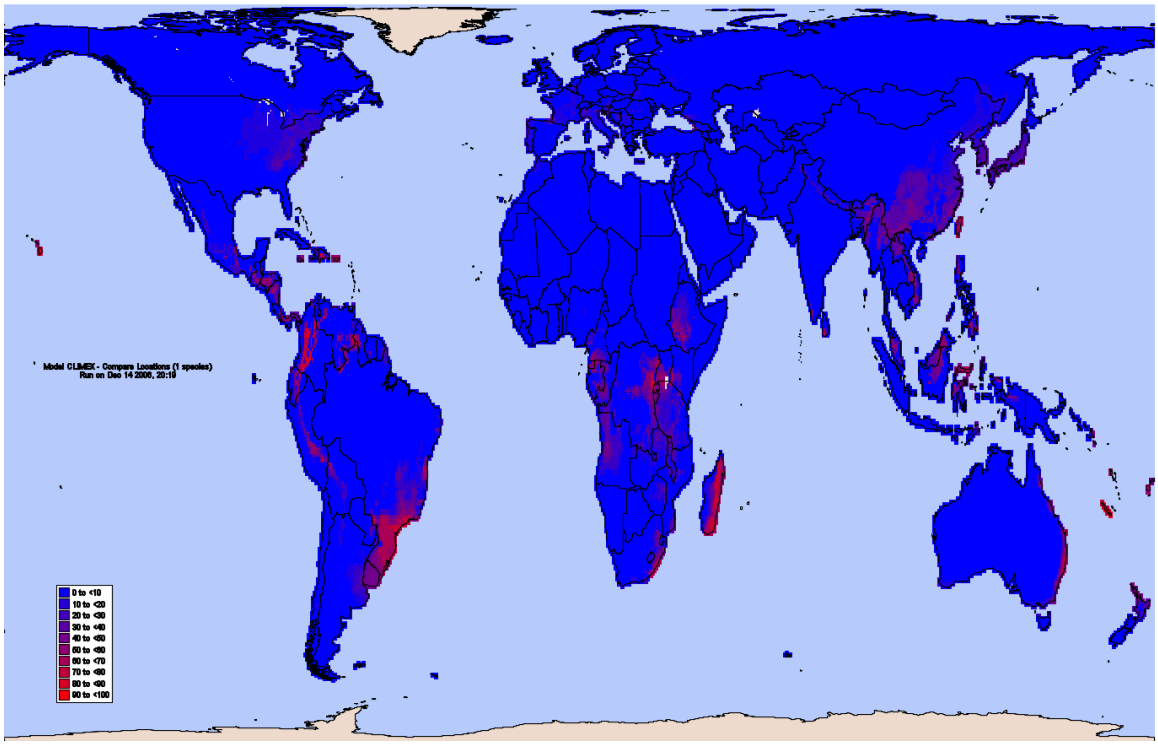

Fig. 10: *Polygonum perfoliatum* Ecoclimatic Indices for the World (Temperate Template, no cold stress, no wet stress, soil moisture minimum to 0.35, maximum temperature 36ºC, DV1=12°C)

A map of the potential Europe distribution is made (Fig. 11).

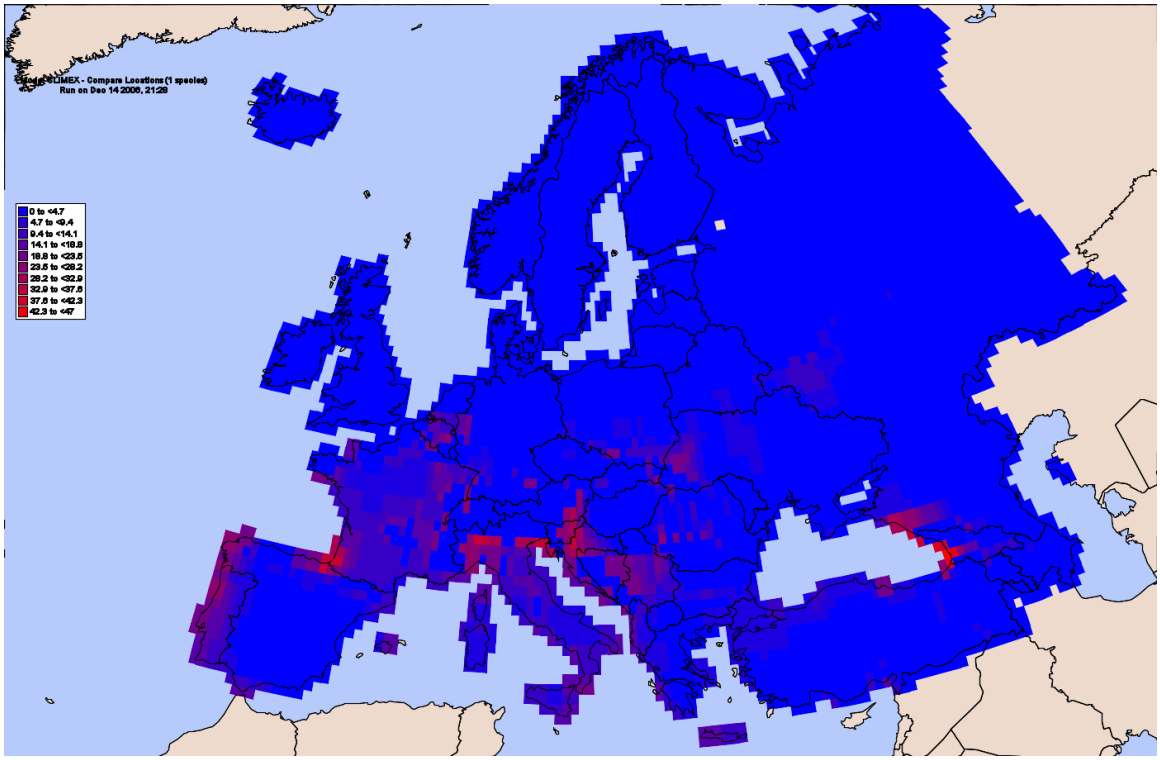

Fig. 10: *Polygonum perfoliatum* Ecoclimatic Indices for Europe, 30 minutes latitude/longitude resolution (Temperate Template, no cold stress, no wet stress, soil moisture minimum to 0.35, maximum temperature 36ºC, DV1=12°C)

Further work would be needed, for example by undertaking a sensitivity analysis, to determine the key parameters influencing the distribution and thus to provide some support for the European map.

Comparison of maps between 30 minute and the 10 minute gridded global climatologies

The similarities between the results obtained using the 30 minute and the 10 minute gridded global climatologies can be observed in Figs 12 and 13. Ten minute grid provides greater spatial resolution and therefore more accuracy.

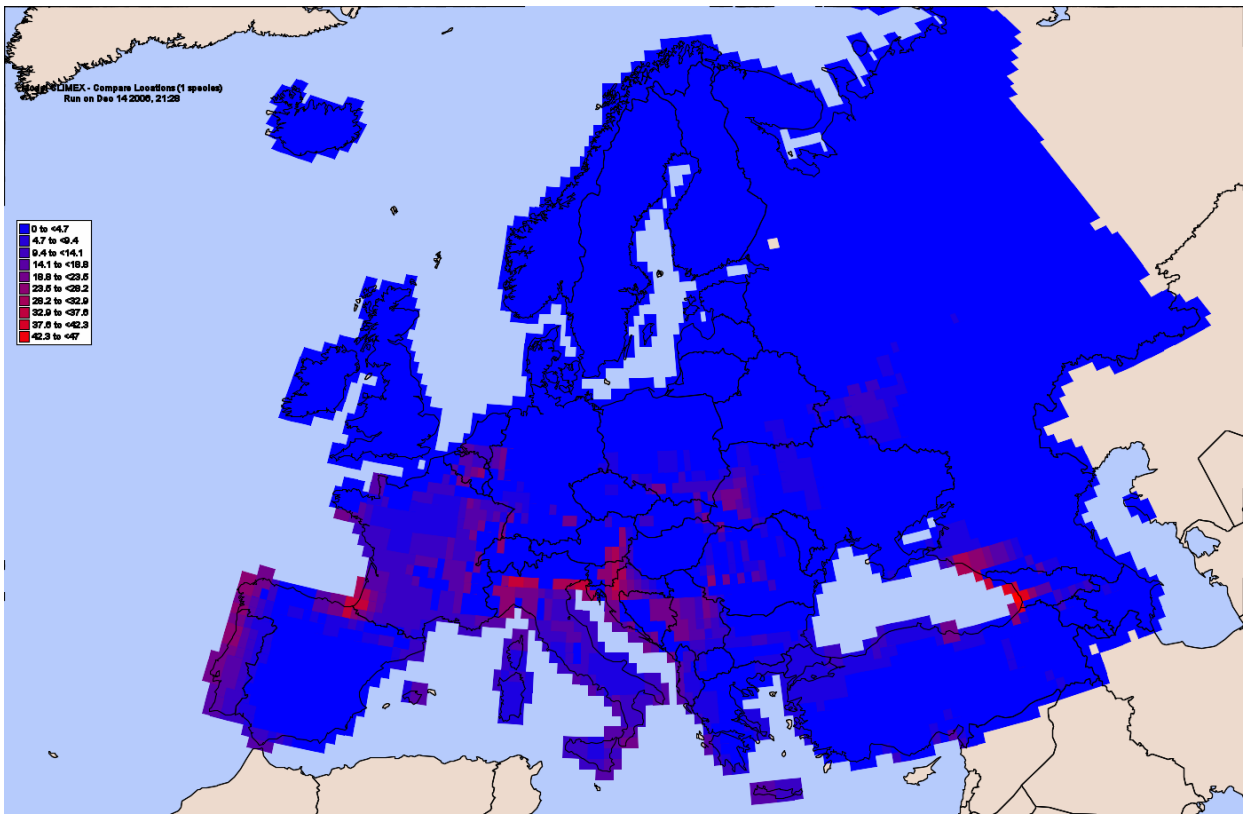

Fig. 12: *Polygonum perfoliatum* Ecoclimatic Indices for Europe, 30 minutes latitude/longitude resolution (Temperate Template, no cold stress, no wet stress, soil moisture minimum to 0.35, maximum temperature 36ºC, DV1=12°C)

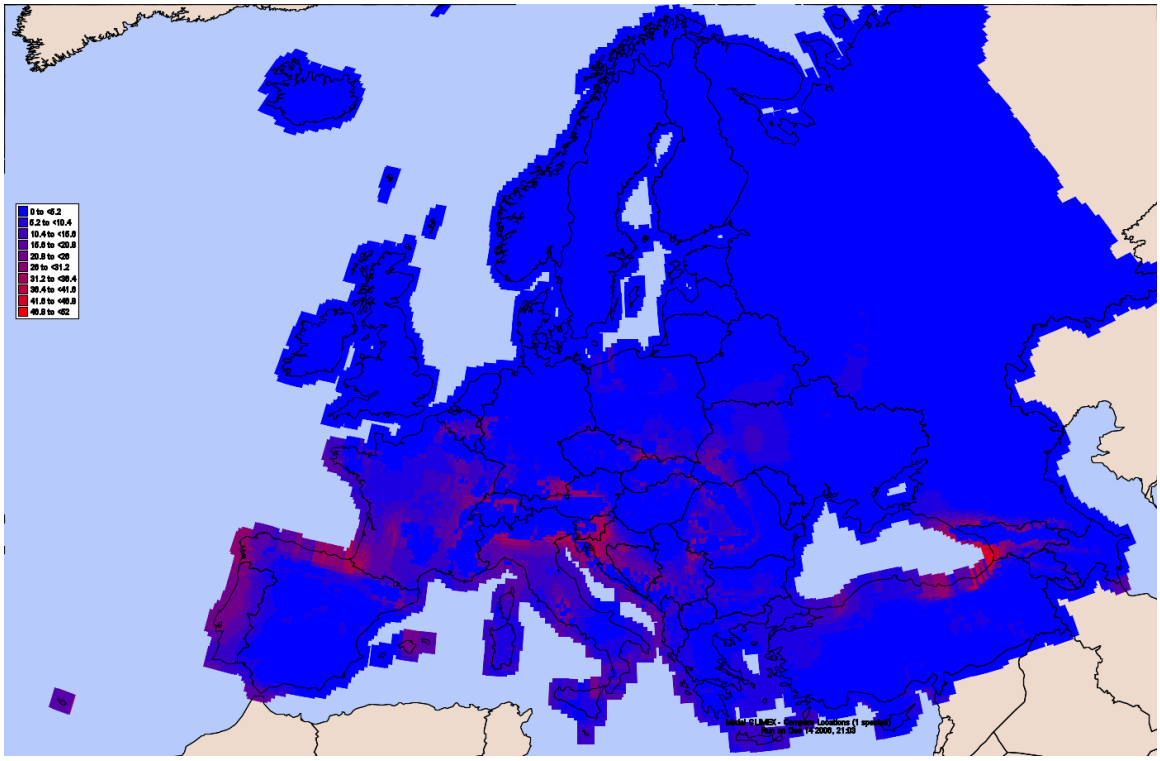

Fig. 13: *Polygonum perfoliatum* Ecoclimatic Indices for Europe, 10 minutes latitude/longitude resolution (Temperate Template, no cold stress, no wet stress, soil moisture minimum to 0.35, maximum temperature 36ºC, DV1=12°C).

Importation of the final map of climatic prediction of *P. perfoliatum* for Europe

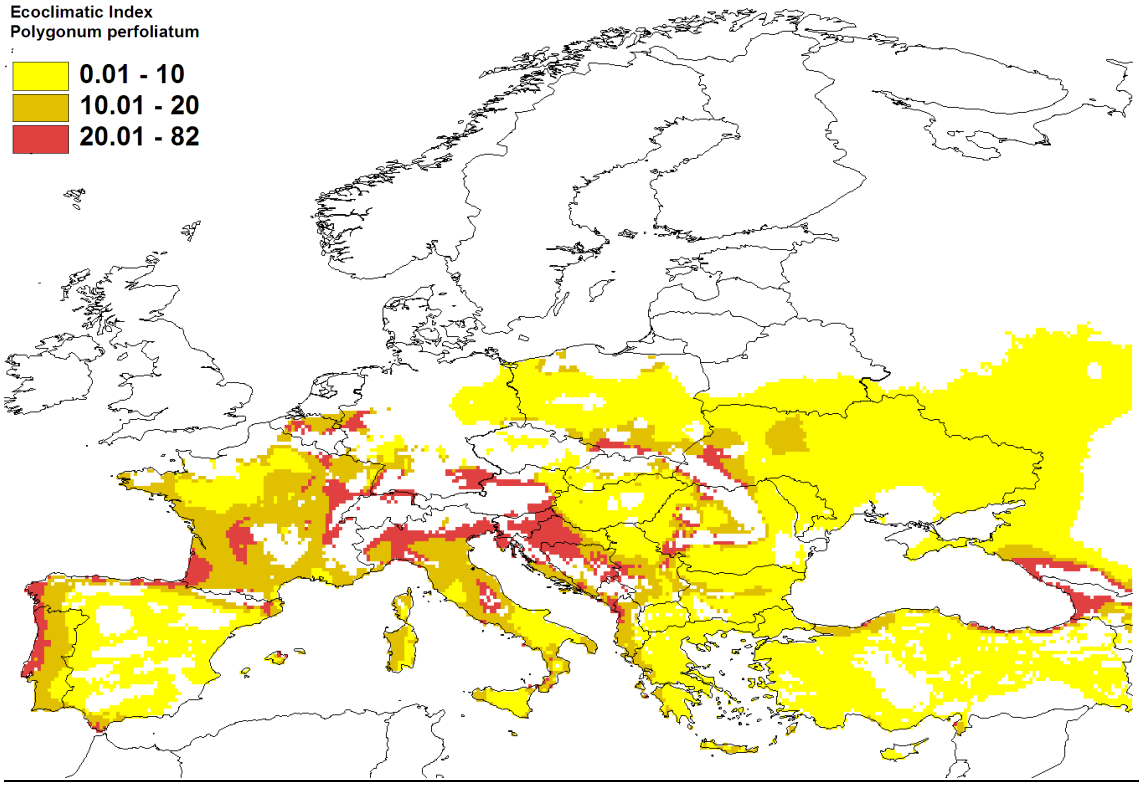

Fig. 13: *Polygonum perfoliatum* Ecoclimatic Indices for Europe, Imported to ArcGIS (Temperate Template, no cold stress, no wet stress, soil moisture minimum to 0.35, maximum temperature 36ºC, DV1=12°C).

Conclusion

If the use of both the Match Index and Compare Locations components of CLIMEX for *P. perfoliatum* are compared with Figures 3 and 13, the countries of Europe at risk are estimated to be: Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Croatia, France, Georgia, Germany, Italy, Montenegro, Poland, Portugal, Romania, Russia, Slovenia, Serbia, Spain, Switzerland, Turkey, Ukraine.
The current distribution in Turkey (Rize, Ardeşen, on the Black Sea) perfectly coincides with the prediction.

The comparison of these figures also shows that the northern Adriatic and the area along the Atlantic coast border between France and Spain are most similar to Taipei and have the highest ecoclimatic indices. This is reassuring but further work should be undertaken to compare other locations using the Match Index CLIMEX module and determine the sensitivity of the parameters selected in the Compare Locations CLIMEX module. For example, a greater area of Europe has a similar April-October climate to Pittsburgh (Fig. 2) than to Taipei but the interpretation of these two maps needs a greater understanding of the plant in both locations. For both modules, much greater progress would be made if the current distribution of the plant could be determined in greater detail, in particular to identify locations where *P. perfoliatum* is most abundant (climatic conditions are most suitable), and to determine the minimum threshold for development and the number of degree days needed to complete its life cycle.

Further work could consist in comparing this climatic prediction map with habitats maps (e.g. CORINE landcover) so habitats at risk could be identified.