Emerging invasive alien plants for the Mediterranean Basin

S. Brunel[1], G. Schrader[2], G. Brundu[3] and G. Fried[4]

[1]*European and Mediterranean Plant Protection Organization, Paris (France); e-mail: sb@eppo.fr*
[2]*Julius Kuehn-Institute, Institute for National and International Plant Health, Braunschweig (Germany)*
[3]*Corpo Forestale e di Vigilanza Ambientale della Regione Autonoma della Sardegna, Direzione Generale, Cagliari (Italy)*
[4]*LNPV Station de Montpellier, Montpellier (France)*

A major step in tackling invasive alien plants consists of identifying those species that represent a future threat to managed and unmanaged habitats. The European and Mediterranean Plant Protection Organization reviews and organizes data on alien plants in order to build an early warning system. A prioritization system is being developed to select species that represent emerging threats and require the most urgent pest risk analysis to implement preventive measures and to perform eradication and management measures. Attention has been drawn to the Mediterranean Basin which is particularly vulnerable because its climatic conditions potentially allow the establishment of sub-tropical and tropical species. Surveys and rapid assessments of spread and impact have allowed identification of emerging invasive alien plants for Mediterranean countries: *Alternanthera philoxeroides* (Amaranthaceae), *Ambrosia artemisiifolia* (Asteraceae), *Baccharis halimifolia* (Asteraceae), *Cortaderia selloana* (Poaceae), *Eichhornia crassipes* (Pontederiaceae), *Fallopia baldschuanica* (Polygonaceae), *Hakea sericea* (Proteaceae), *Humulus japonicus* (Cannabaceae), *Ludwigia grandiflora* and *L. peploides* (Onagraceae), *Hydrilla verticillata* (Hydrocharitaceae), *Microstegium vimineum* (Poaceae), *Myriophyllum heterophyllum* (Haloragaceae), *Pennisetum setaceum* (Poaceae), *Pistia stratiotes* (Araceae), *Salvinia molesta* (Salviniaceae), *Solanum elaeagnifolium* (Solanaceae). These species represent priorities for action. Some other species are placed on the observation list, as available information does not allow them to be counted among the worst threats: *Akebia quinata* (Lardizabalaceae), *Araujia sericifera* (Apocynaceae), *Delairea odorata* (Asteraceae), *Cabomba caroliniana* (Cabombaceae), *Nassella neesiana*, *N. tenuissima* and *N. trichotoma* (Poaceae), *Sesbania punicea* (Fabaceae), and *Verbesina encelioides* (Asteraceae).

Introduction

With increasing trade at the global scale and the opening of new markets, the need to tackle plant pests is more important than ever. When new phytosanitary risks are discovered or suspected, the first step to protect countries from introduction and spread of plant pests is an effective early warning system. Several preconditions have to be fulfilled to make such an early warning system effective, reliable and readily available. These include:

(a) obtaining information on new emerging pests as soon as possible;
(b) distributing the collected data widely and to the relevant persons/authorities;
(c) providing sufficient information to detect and identify the pest.

The European and Mediterranean Plant Protection Organization (EPPO) are deeply involved in early warning of invasive alien species. The main aim of EPPO is *'to pursue and develop, by cooperation between the Member Governments, the protection of plants and plant products against pests and the prevention of their international spread and especially their introduction into endangered areas'*. One of EPPO's tasks is therefore to draw up lists of pests which present a phytosanitary risk, and whose regulation is relevant for the whole of, or parts of, the EPPO region, composed of 50 European and Mediterranean countries. Alien plants can be placed on different lists, some of which were initially designed for classical pests (insects and mites, bacteria and phytoplasmas, viruses, viroids and nematodes). The A1 list contains pests not present in the EPPO region. The A2 list contains pests that are present in the EPPO region, but which are not widely distributed (i.e. absent from or not widely distributed in certain countries, where they are subject to official control). The first A1 and A2 lists were approved in 1975. In 2010, they contained 302 quarantine pests recommended for regulation (data available on the EPPO website). Concerns about the threats posed by invasive alien plants (IAPs) have increased in recent years and since 2002, 8 IAPs are recommended for regulation by EPPO and listed in the A2 list. So far no IAPs are listed on the A1 list, as priority was given to those species already present in the region to raise awareness and motivate action.

Addition of a pest to the A1 or the A2 list is proposed when a Pest Risk Analysis (PRA), following the standards of the International Plant Protection Convention (IPPC) and EPPO, conducted on an organism suggested by at least one member country or by EPPO, has revealed a phytosanitary risk to the EPPO region or part of it. Prior to being selected for a PRA,

invasive alien plants are added to the EPPO Alert List, which is a pest warning system managed by the EPPO Secretariat, and information on pests listed in the Alert List is published in the EPPO Reporting Service (See EPPO Website, 2010). Organisms in this list are selected by the EPPO Secretariat (based on literature review, new occurrences, new records of invasiveness) or are proposed by National Plant Protection Organisations. Pests (other than invasive alien plants) are kept in the list until a PRA has been conducted or removed after 3 years if no action has been taken. The procedure for dealing with invasive alien plants is currently being discussed and elaborated, as there are many species to consider as the interest is new, and as only a few PRAs can be performed due to time constraints.

In addition to the A1, A2 and Alert List, and because there are already many invasive alien plants to consider, EPPO also drafted in the earlier stages of its work a list highlighting the 42 most invasive alien plants in the EPPO region (called the EPPO List of Invasive Alien Plants). This list aims to draw attention to those species whose entry into EPPO countries the should be prevented, or should be submitted to control measures to prevent further spread.

Within the EPPO region, the Mediterranean Basin is particularly vulnerable because its climatic conditions potentially allow the establishment of both sub-tropical and tropical species. In the context of climate change, the potential to establish and cause damages may increase (Sala *et al.*, 2000; Walther *et al.*, 2009). Negative impacts on the rich Mediterranean biodiversity are expected. Many valuable habitats are already at risk due to the inability of species to cope with rapid shifts in climatic conditions. This is particularly true for Mediterranean temporary and permanent wetlands whose waterfowl and fisheries may be lost. Aquatic invasive alien plants would exacerbate these threats by invading wetland habitats and competing with indigenous species (Brunel & Fernandez-Galiano, 2010).

Although the Mediterranean Basin might suffer the worst impacts caused by invasive alien plants, there is an alarming lack of data and awareness in this area. There is thus an urgent need to gather, analyse and share lists of invasive alien plants. Initial attempts to fill this gap occurred in the framework of the organization of conferences and workshops (see Di Castri *et al.*, 1990 and Brunel, 2006). Currently, not all Mediterranean Basin countries have published lists of invasive alien plants, although notable projects were undertaken in certain countries and by the EU funded projects Epidemie and DAISIE.

This article aims to: (a) describe the methodology followed to highlight priority alien plants for action; and (b) draw attention to a set of these alien species that represent management priorities for the Mediterranean Basin countries. The current distribution of these species is still limited – which means that intervention is still feasible – while their potential to spread and to threaten both managed and/or unmanaged habitats is high. This study is not exhaustive, rather it intends to contribute to the regional state of the art on invasive alien plants.

Material and methods

The study area

The Mediterranean Basin has been defined in this study according to Med-checklist (Greuter *et al.*, 1984–1989), i.e. relying on political borders. Part or the whole of the following countries are considered to be part of the Mediterranean area: Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Egypt, France (including Corsica), Greece (including East Aegean Islands, Crete, Karpathos), Israel, Italy (including Sardinia, Sicily), Jordan, Kosovo, Libya, Lebanon, Macedonia, Malta, Montenegro, Morocco, Portugal, Serbia, Slovenia, Spain (including Balearic Islands, Canary Islands), Syria, Tunisia and Turkey (see Fig. 1). Some of these countries are not yet part of the EPPO region (e.g. Syria, Egypt), and many of them were not taken into consideration by previous European Union funded projects that collected data for European or Mediterranean inventories and databases, e.g. DAISIE (Lambdon *et al.*, 2008; Hulme *et al.*, 2010) and Epidemie (Hulme *et al.*, 2008), as these projects were limited to member countries of the European Union.

Data collection

In May 2005, the French National Mediterranean Botanical Conservatory in partnership with EPPO, World Conservation Union (IUCN) Centre for Mediterranean Cooperation and the Council of Europe, organised the 1st International Workshop on Invasive

Fig. 1 Map of the Mediterranean Basin area considered for the study. Adapted from EEA Biogeographical map of Europe and from Groves & Di Castri (1991).

Alien Plants in Mediterranean Type Regions of the World in Mèze (France) (25–27 May 2005). As a preparatory study for the workshop, a survey on invasive alien plants in the Mediterranean Basin was undertaken. Data was collected using an e-mail questionnaire.

Different lists of species considered invasive by different experts from many countries in the Mediterranean area were collected; they have been shared with all participants of the workshop and interested experts, but have never been published.

Since this workshop, information has been enriched and periodically updated by the EPPO Secretariat. It provided the basis for drafting an Alert list of plants which are present in the EPPO countries of the Mediterranean Basin but not widespread (A2 species), and which have shown invasive behaviour in other Mediterranean and subtropical regions of the world.

The overall gross results of this initial work together with the number of plants considered to be alien and/or invasive and the source of the information are provided in Table 1. Other available data and inventories published for the Mediterranean region (i.e. DAISIE, Flora Europaea) were also taken into account. Figures are, of course, only indicative, due to different definitions of invasiveness used by the different authors.

Filtering and prioritizing species

Since 2006, EPPO has been engaged in the drafting of a method for prioritizing alien plants, based on relatively simple but robust

Table 1 Information on alien plants and plants considered invasive in some Mediterranean countries. Alien plant species given in references were provided and the number of invasive taxa was provided in brackets, when available. No information (N/A) was available for Egypt, Jordan, Kosovo, Lebanon or Libya

Mediterranean countries	Island territories	Responded to EPPO survey Y/N	Flora Europaea	DAISIE Y/N	Number of alien taxa listed	Main reference for alien flora/list
Albania		N	Y	N	N/A	
Algeria		N		N	143	Vilà *et al.*, 1999
Andorra		N	Y	Y	52	Lambdon *et al.*, 2008
Bosnia & Herzegovina		N	Y	N	N/A	
Bulgaria		Y	Y	Y	708	Lambdon *et al.*, 2008
Croatia		Y	Y	Y	157 (64)	Lambdon *et al.*, 2008; Boršić *et al.*, 2008
Croatia	Other islands	N	N	Y	4	e.g. Pandža *et al.*, 2002
Cyprus		Y	N	Y	209	Lambdon *et al.*, 2008
France		Y	Y	Y	1258	Lambdon *et al.*, 2008
France	Corsica	N	Y	Y	500	Natali & Jeanmonod, 1996
Gibraltar		N	Y	N	N/A	
Greece		Y	Y	Y	315	Lambdon *et al.*, 2008
Greece	Crete	N	Y	N	245	Dal Cin D'Agata *et al.*, 2010
Israel		Y	N	Y	187	Lambdon *et al.*, 2008
Italy		Y	Y	Y	1023 (163)	Celesti-Grapow *et al.*, 2009
Italy	Sardinia	Y	Y	Y	236	Camarda, 2001; Brundu *et al.*, 2003
Italy	Sicily	N	Y	N	256	Celesti-Grapow *et al.*, 2009
Italy	Other islands	N	N	N	4–68	Pretto *et al.*, (in prep.).
Macedonia		N		Y	25	Lambdon *et al.*, 2008
Malta		Y	N	Y	183	Lambdon *et al.*, 2008
Monaco		N		N	~100 (34)	Médail *et al.*, 2007
Montenegro		N	Y	N	N/A	
Morocco		Y		N	(15)	Taleb & Bouhache, 2009
Portugal		Y	Y	Y	547	Lambdon *et al.*, 2008
Portugal	Madeira	N		Y	659	Lambdon *et al.*, 2008
Portugal	Azores	N	Y	Y	918	Lambdon *et al.*, 2008
San Marino		N		N	N/A	
Serbia		Y	Y	N	N/A	
Slovenia		Y		Y	750	Lambdon *et al.*, 2008
Slovenia	Other islands	N	Y			
Spain		Y	Y	Y	933	Lambdon *et al.*, 2008
Spain	Balearic Islands	Y	Y	Y	339	Lambdon *et al.*, 2008
Spain	Canary Islands	Y		Y	258 (22)	Lambdon *et al.*, 2008; Gallo *et al.*, 2008
Syria		Y	N	N	N/A	
Tunisia		N	N	N	60	Vilà *et al.*, 1999
Turkey		N	Y	Y	220	Lambdon *et al.*, 2008

criteria. As performing full Pest Risk Analysis (PRA) for all the invasive alien plants already present within the EPPO region would require a vast input of resources, the general philosophy of the prioritizing process is to select those species for which a PRA constitutes an adequate tool. PRA is intended to provide technical justification for countries when imposing restrictions on international trade so as to protect their territory against these invasive alien plants. For invasive alien plants introduced for ornamental purposes, the most stringent preventive measure consists of a ban on import and trade of the species.

First step of the prioritization process

The prioritization method is currently under elaboration and test. A set of criteria is used to address biogeographical and ecological features and (potential) impacts of the target species, with the following questions:

(a) Is the species known to be alien in all or a significant part of the EPPO region?
(b) Is the species established in at least one EPPO country?
(c) Is the plant known to be invasive outside the EPPO region?
(d) Could the species establish in the EPPO region (when not established yet)?
(e) How high is the spread potential of the plant?
(f) How high is the (potential) impact on native species, habitats and ecosystems?
(g) How high is the potential negative impact of the species on agriculture, horticulture or forestry?

As a result, the first step of the process produces the following lists:

- a list of invasive alien plants or potential invasive plants, grouped according to whether they are already established in the EPPO region or not;
- an observation list of alien species that would become of concern if shifts in their invasive behaviour occur.

Finally, species that do not fall in any of the lists described above are considered of less concern. For each assessment, the level of uncertainty (low, medium or high) for each question is recorded and summarized.

Second step of the prioritization process

The second step of the prioritization process consists of determining which of the invasive and potentially invasive alien plants have the highest priority for an EPPO Pest Risk Analysis. This assessment is based on the following 4 criteria:

(a) Is the species internationally traded or are there other existing or potential international pathways?
(b) Is the risk of introduction by these international pathways identified to be superior to natural spread?
(c) Does the species have a significant area suitable for further spread in the EPPO region?
(d) Based on available information, would eradication/containment be technically feasible?

As a final result, some invasive alien plants are considered as priorities for a PRA (as they have a limited distribution, and their eradication or containment is feasible). Some other invasive alien plants are not considered as priorities for a PRA, but national management and the use of a Code of conduct might be regarded as the most relevant action (widespread species that are not easily managed).

Results

The Mediterranean list

Twenty-nine questionnaires were received in 2005 from the following countries: Algeria, Armenia, Bulgaria, Cyprus (2), France (2), Israel (2), Italy (2 from the mainland and 1 from Sardinia), Lebanon, Malta, Morocco, Portugal (3), Serbia and Montenegro (2), Slovenia, Spain (4 from the mainland, 2 from Balearic Islands, 1 from Canary Islands) and Syria (see list of contacts in the acknowledgements).

These questionnaires allowed a list of about 600 alien plant taxa considered invasive to be collected. The invasive plant lists that were gathered have no official status from a legislative point of view, as no official lists exist, with few exceptions such as that of Portugal (Decree no. 565/99, 21 December 1999) and of the Lombardy region in North Italy (Regional Law no. 10, 31 March 2008; Decree no, 7736, 24 July 2008).

One important result, as revealed from the answers received, is that quite often the definition and perception of what is an 'invasive plant' greatly varied from one expert to another. For instance, indigenous species were sometimes considered as invasive.

Additionally, methods to create invasive plants lists vary between countries. The elaboration of these lists is usually done based on 'observations', 'bibliographical work' or 'expert knowledge'.

Results of the prioritization process on some invasive alien plants in the Mediterranean Basin

The collected list of species was assessed through a preliminary version of the prioritization process (see Brunel & Tison, 2005 for details on the method). This work allowed the identification of emerging invasive alien plants among the 600 species listed worthy of efforts for prevention (in those countries not yet affected) or management. Those selected species have been the object of further bibliographical study within the EPPO framework, some were included in the EPPO Alert List while others were the object of a note in the Reporting Service. During the development of the prioritization process by the EPPO Panel on Invasive Alien Species, the evaluation of these emerging alien plants raised discussions between experts of the Mediterranean area. Such comparison allowed the species to be classified in different lists:

- the species that represent an emerging threat and are placed on the list of invasive or potentially invasive alien plants;
- the species for which further information is needed on their behaviour which are placed on the observation list;
- the species considered of less concern.

Species of relevance for the Mediterranean Basin currently falling into these 3 categories and their impacts are briefly described in the Appendix. They are listed in alphabetical order

within each category, and the uncertainty attached to the assessment is mentioned. Table 2 summarizes the major elements of the assessment.

Discussion

Apart from damaging biodiversity, many invasive alien species among those already established in the EPPO region have imposed huge losses on the economy, affecting, for example, human, animal and plant health, agriculture, forestry, fisheries, land stability and infrastructures (Kettunen *et al.*, 2008; Vilà & Basnou, 2008). The European Union has identified proliferation of invasive alien species as an emerging issue and its Environmental Council has, on the 25 June 2009, stressed the need for a European Strategy on invasive species. Existing initiatives in Europe are acknowledged as the European Commission communication takes into account '*in particular the guiding principles enshrined in relevant CBD decisions*, *the European Strategy on Invasive Alien Species under the Convention on the Conservation of European Wildlife and Natural Habitats*, *and the European*

Table 2 Results of the prioritization process for the emerging species, species to be observed and species of less concern in the Mediterranean Basin, including known occurrence in EPPO countries, evaluation of spread, environmental impacts, impacts on agriculture and forestry and the overall uncertainty for the assessment of the species, according to the EPPO prioritization process

Species	Known occurrence	Spread	Impact on the environment	Impact on agriculture and forestry	Uncertainty
Emerging invasive alien species in the Mediterranean Basin					
Alternanthera philoxeroides (Amaranthaceae)	FR, IT	High	High	Medium	Medium
Ambrosia artemisiifolia (Asteraceae)	AT, BE, CZ, DK, FR, DE, FI, HU, IT, MD, NO, LU, PL, PT, RO, RU, SK, GB, UA, HR	High	Low	High	Low
Baccharis halimifolia (Asteraceae)	BE, FR, IT, ES, GB	High	High	Low	Low
Cortaderia selloana (Poaceae)	ES, FR, IT, PT TR	High	High	Low	Low
Eichhornia crassipes (Pontederiaceae)	ES, IS, IT, JO, PT	High	High	High	Low
Fallopia baldschuanica (Polygonaceae)	DE, DK, FR, IE, ES, IT, SI	Medium	High	No information	High
Hakea sericea (Proteaceae)	FR, PT, ES	High	High	No information	Low
Humulus japonicus (Cannabaceae)	FR, HU, IT	Medium	High	No information	High
Ludwigia grandiflora and *L. peploides* (Onagraceae)	BE, DE, ES, FR, IT, NL, TR	High	High	High	Low
Hydrilla verticillata (Hydrocharitaceae)	IE, LV, LT, PL, RU	High	High	Low	Medium
Microstegium vimineum (Poaceae)	TR	High	High	No information	Medium
Myriophyllum heterophyllum (Haloragaceae)	AT, DE, ES, NL, BE, HU (to be confirmed)	High	High	High	High
Pennisetum setaceum (Poaceae)	FR, IT, ES	High	High	Low	Medium
Pistia stratiotes (Araceae)	ES	High	High	Low	Medium
Salvinia molesta (Salviniaceae)	IT	High	High	Low	Medium
Solanum elaeagnifolium (Solanaceae)	CY, ES, FR, GR, HR, IT, MA, RS, TR	High	Low	High	Low
Species to be observed in the Mediterranean Basin					
Akebia quinata (Lardizabalaceae)	CH, FR, GB	Medium	Medium	Low	High
Araujia sericifera (Apocynaceae)	ES, FR (Corsica), GR, IL, IT, PT (Azores, Madeira)	High	Medium	Medium	Medium
Delairea odorata (Asteraceae)	FR, IE, IT, HR, PT (incl. Azores, Madeira), ES (incl. Canary Islands)	Medium	Medium	Low	Medium
Cabomba caroliniana (Cabombaceae)	BE, FR, HU, NL, GB	High	Medium	Medium	Medium
Nassella neesiana, *N. tenuissima* and *N. trichotoma* (Poaceae)	ES, FR, IT	Medium to High	Medium	Medium	Medium
Sesbania punicea (Fabaceae)	FR (Corsica), IT (Sicily, Sardinia)	Medium	Medium	Low	Medium
Verbesina encelioides (Asteraceae)	DE, ES, IL, MA, GB	High	Medium	Medium	Medium
Species of less concern in the Mediterranean Basin					
Alternanthera pungens (Amaranthaceae)	ES	Medium	Low	Medium	Low
Cotula coronopifolia (Asteraceae)	BE, DE, DK, ES (incl. Balearic Islands), FR (incl. Corsica), GR, IT (incl. Sardinia), NL, NO, PT, SE, GB	Medium	Medium	No information	Medium
Eichhornia azurea (Pontederiaceae)	/	Medium	Medium	Medium	Medium

and Mediterranean Plant Protection Organisation recommendations, as well as existing EU plant health legislation such as Directive 2000/29/EC on protective measures against the introduction of organisms harmful to plants' (EU COM, 2008). The European Strategy on Invasive Alien Species (Genovesi & Shine, 2002; European Commission Website, 2010) contains an introduction and 8 sections that are cross-referenced to relevant CBD guiding principles. Each of these 8 sections relates to a specific aim, key actions and practical indicators for additional actions: (a) building awareness and support; (b) collecting, managing and sharing information; (c) strengthening policy, legal and institutional frameworks; (d) regional cooperation and responsibility; (e) prevention; (f) early detection and rapid response; (g) mitigation of impacts; (h) restoration of native biodiversity.

EPPO efforts aim to collect and update lists, prioritize emerging invasive alien plants and bring this information to the countries. Analysing information and sharing it at the regional scale allows countries to save time and resources, and therefore focus on those species already present in their territories or in neighbouring regions and implement actions and policy measures. Identifying those species that represent the major potential threats while at an early stage of invasion represents a major predictive challenge. The EPPO Lists are far from being exhaustive. Numerous invasive alien plants deserve further attention. In this regard, the EPPO Secretariat and experts are engaged in an ongoing analysis of species and updates. This should nevertheless not prevent countries in taking action on the known existing emerging invasive alien plants. With the current information and tools provided by EPPO, countries are now able to implement national legislation on invasive alien plants, to undertake eradication or containment actions, as well as to undertake programmes with the horticultural industry responsible for the entry of new plants.

Pest risk analysis provides a scientific and technical justification to impose measures on international trade (e.g. to prohibit the import of an invasive alien plants introduced for ornamental purposes) (see Brunel *et al.*, 2009 for further details). PRA is an indispensable tool when designing the European or national legislation for invasive alien plants. There are already 8 IAPs for which an EPPO pest risk analysis is available: *Crassula helmsii* (Kirk) Cockayne (Crassulaceae), *Eichhornia crassipes* (Martius) Solms-Laubach (Pontederiaceae), *Heracleum persicum* Fischer and *Heracleum sosnowskyi* Mandenova (Apiaceae), *Hydrocotyle ranunculoides* C. L. (Apiaceae), *Polygonum perfoliatum* (L.) L. (Polygonaceae), *Pueraria lobata* (Willdenow) Ohwi (Fabaceae) and *Solanum elaeagnifolium* Cav. (Solanaceae). Extensive information on these species is available on the EPPO website. This provides countries with the technical justification when including the species in their national lists to prohibit the import of these species.

Additionally, the EPPO Lists provide an effective pro-active early warning system to prevent the introduction from neighbouring countries and spread of such species in the EPPO region or in the Mediterranean Basin. Indeed, where and when achievable, (early) eradication and containment of an invasive alien species are generally seen as the best management option after prevention has failed. Eradication is more cost effective than ongoing management, and prevents further environmental impacts. Technical improvements (e.g. availability of active substances of herbicides, availability of biological control agents) are increasing the number of situations and habitats where eradication is feasible, especially on islands (IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species, prepared by the SSC Invasive Species Specialist Group, approved by the 51st Meeting of the IUCN Council, Gland Switzerland, February 2000). EPPO IAPs lists, datasheets, reporting service and prioritization are useful tools for cooperation between countries and regions for prevention and for pro-active early warning. Nevertheless, even when potential future threats are identified and promoted, the lack of understanding of the damage caused by IAPs, and the lack of experience with the practical implementation of preventive and eradication measures for plants impede actions to be effectively undertaken. There are indeed few bans of import of renowned invasive alien plants and eradication actions undertaken in Mediterranean countries.

Most of the species described in this work have been introduced for ornamental purposes. In recent times, the vast majority (80%) of invasive alien plants in Europe were initially introduced and used as ornamental plants (e.g. Hulme, 2007). The ornamental plants sector represents a major pathway for introducing very well known invasive alien plants in other regions of the world as well, as in South Africa (Foxcroft *et al.*, 2008) or in tropical islands (Meyer & Lavergne, 2004). In particular, ornamental aquatic plants may represent major risks, as highlighted by Brunel (2009) and Andreu & Vilà (2010). The Mediterranean Basin is considered particularly at risk because its climatic conditions potentially allow the establishment of sub-tropical and tropical species. In the context of climate change, these threats may increase. While the origin of invasive alien plants in Europe are mainly from North-America, as the trade markets were mainly organized with this continent, the emerging market for ornamental plants from China and India represent routes of introduction of future invaders that deserve further attention. The trends in horticulture and the markets evolve a lot faster than any possible attempts of assessors to perform Pest Risk Analyses on new invasive species to prevent their entry. A generic tool to raise awareness among the horticultural professionals and the general public and to propose management solutions is the 'Code of conduct on horticulture and invasive alien plants' (EPPO, 2009; Heywood & Brunel, 2009). This Code of conduct intends to raise awareness of the horticultural profession of the damages caused by invasive alien plants and their responsibility in it, and to encourage them to take voluntary actions to stop the sale of those invasive species, and to replace them by non-invasive ones. Such initiatives have already encountered good responses and the Code of conduct has already been translated into Spanish, Polish and Czech.

Conclusions

The EPPO lists of invasive alien plants for the Mediterranean Basin are intended to reflect the state of the art of the current

knowledge. They will be further updated after the 2nd Workshop on Invasive Alien Plants in Mediterranean Type Regions of the World in Trabzon (Turkey) on the 2nd to the 6th of August 2010. In the framework of this 2nd Workshop, a survey has been sent widely to gather further lists of invasive plants for the Mediterranean, as well as eradication actions undertaken.

Although not final and exhaustive, the list of species presented in this article as a priority for action allows Governments and other institutions involved in the field of plant protection or environment conservation to undertake monitoring, prevention and eradication, containment or management actions in their countries.

It is hoped that the existing EPPO tools and activities (lists of species, datasheets, reporting service, the prioritization process, the Code of conduct, the organization of the 2nd workshop on invasive alien plants in the Mediterranean Type Regions of the World as well as other workshops) will enhance interest, dialogue and cooperation among IAP experts of Mediterranean countries. Contribution from these countries through new reports of species and actions undertaken are most welcome as it is essential to continue to share the ongoing flow of information.

Acknowledgements

Persons who responded to the 2005 survey are particularly acknowledged:

List of persons who provided information during the survey launched in 2005, with the institution they were working for at the time of the survey:

Bulgaria V Vladimirov, Institute of Botany, Bulgarian Academy of Sciences,

Croatia B Mitíc, Department of Botany, Faculty of Sciences, University of Zagreb,

Cyprus T Tsintides and C Christodoulou, Parks and Environment Sector, Forestry Department, Ministry of Agriculture Natural Resources and Environment, Eleftherios Hadjisterkotis, Ministry of the Interior.

East Algeria Mohamed Fenni, Département d'Agronomie, Faculté des Sciences, Université Ferhat Abbes Sétif, Djamel Sarri, Université Mohamed Boudief, Département de Biologie,

Greece E. Arvanitakis, Director of Crop Protection, Ministry of Agriculture.

Italy L Celesti-Grapow, University of Rome La Sapienza

Israel JM Dufour-Dror. A Danin, Department of Evolution, Systematics, and Ecology, The Hebrew University of Jerusalem.

Malta D Stevens, Malta environment & Planning Authority.

Morocco A Taleb, Institut Agronomique et Vétérinaire Hassan II.

Spain – Balearic Islands F Pons, V Mayol Serra, Servei de Protecció d'Espècies. Ministry of the Environment. Balearic Government.

Serbia and Montenegro O Vasic, Natural History Museum Belgrade.

D Stesevic, D Petrovic, S Vuksanovic and Nada Bubanja, Faculty of Sciences and Natural.

Natural History Museum (for the urban area of Podgorica (capital), Babji zubb (central part) and Ulcinjska beac (Southern part)).

Slovenia – Mediterranean part N Jogan, Department of Biology, University of Ljubljana.

Syria A Al Mouemar, Faculte d'Agronomie-Protection des Vegetaux-Laboratoire de Malherbologie, Universite de Damas.

A special acknowledgement is given to JM Tison for helping to analyse the lists of species in the first steps of the process. The EPPO experts of the Panel on Invasive Alien Species are acknowledged and particularly experts attending the discussions on the prioritization process: E Branquart (BE), S Buholzer (CH), M Josefsson (SE), U Starfinger (DE), A Uludag (TR), J Van Valkenburg (NL). Acknowledgement is also given to AS Roy and M McMullen for reviewing the article.

Les plantes exotiques envahissantes émergeantes pour le bassin méditerranéen

Une étape essentielle pour s'attaquer au problème des plantes exotiques envahissantes consiste à identifier les espèces qui représentent une menace à venir dans les environnements naturels et aménagés. L'Organisation Européenne et Méditerranéenne pour la Protection des Plantes étudie et organise des données sur les plantes exotiques afin de mettre en place un système d'alerte précoce. Un système de priorisation est en cours d'élaboration pour sélectionner les espèces qui représentent des menaces émergeantes et nécessitent de façon urgente une analyse du risque phytosanitaire avant de mettre en œuvre des mesures préventives et d'appliquer des mesures de gestion et d'éradication. On s'est intéressé au bassin méditerranéen qui est particulièrement vulnérable du fait de ses conditions climatiques qui peuvent permettre l'établissement d'espèces subtropicales et tropicales. Des enquêtes et des évaluations rapides de la dissémination et de l'impact ont permis l'identification de plantes exotiques envahissantes émergeantes pour les pays méditerranéens: *Alternanthera philoxeroides* (Amaranthaceae), *Ambrosia artemisiifolia* (Asteraceae), *Baccharis halimifolia* (Asteraceae), *Cortaderia selloana* (Poaceae), *Eichhornia crassipes* (Pontederiaceae), *Fallopia baldschuanica* (Polygonaceae), *Hakea sericea* (Proteaceae), *Humulus japonicus* (Cannabaceae), *Ludwigia grandiflora* et *L. peploides* (Onagraceae), *Hydrilla verticillata* (Hydrocharitaceae), *Microstegium vimineum* (Poaceae), *Myriophyllum heterophyllum* (Haloragaceae), *Pennisetum setaceum* (Poaceae), *Pistia stratiotes* (Araceae), *Salvinia molesta* (Salviniaceae), *Solanum elaeagnifolium* (Solanaceae). Ces espèces représentent des priorités pour l'action. Certaines autres espèces sont placées sur la liste d'observation, car l'information disponible ne permet pas de les compter parmi les menaces les plus graves: *Akebia quinata* (Lardizabalaceae), *Araujia sericifera* (Apocynaceae), *Delairea odorata* (Asteraceae), *Cabomba caroliniana* (Cabombaceae), *Nassella neesiana*, *N. tenuissima* et *N. trichotoma* (Poaceae), *Sesbania punicea* (Fabaceae) et *Verbesina encelioides* (Asteraceae).

Проблемы, возникающие с инвазивными чужеземными растениями в Средиземноморском бассейне

Главный этап в решении проблемы инвазивных чужеземных растений заключается в определении тех видов, которые представляют собой в будущем угрозу для управляемой и неуправляемой среды обитания. В целях создания системы раннего предупреждения Европейская и Средиземноморская организация по карантину и защите растений рассматривает и сортирует данные по чужеземным растениям,. Система установления приоритетов разрабатывается для того, чтобы выбрать те виды, которые представляют собой возникающие угрозы и требуют проведения наиболее срочного анализа фитосанитарного риска, с тем чтобы можно было предпринимать профилактические меры в их отношении, а также проводить меры по уничтожению и управлению. Внимание было обращено на Средиземноморский бассейн, который особенно уязвим из-за того, что его климатические условия допускают акклиматизацию субтропических и тропических видов. Обследования и оперативные оценки распространения и воздействия позволили определить угрозу появления таких инвазивных чужеземных для средиземноморских стран растений, как: *Alternanthera philoxeroides* (Amaranthaceae), *Ambrosia artemisiifolia* (Asteraceae), *Baccharis halimifolia* (Asteraceae), *Cortaderia selloana* (Poaceae), *Eichhornia crassipes* (Pontederiaceae), *Fallopia baldschuanica* (Polygonaceae), *Hakea sericea* (Proteaceae), *Humulus japonicus* (Cannabaceae), *Ludwigia grandiflora* и *L. peploides* (Onagraceae), *Hydrilla verticillata* (Hydrocharitaceae), *Microstegium vimineum* (Poaceae), *Myriophyllum heterophyllum* (Haloragaceae), *Pennisetum setaceum* (Poaceae), *Pistia stratiotes* (Araceae), *Salvinia molesta* (Salviniaceae), *Solannum elaeagnifolium* (Solanaceae). Эти виды являются приоритетными для ведения конкретных действий. Некоторые другие виды помещены в список для наблюдения, т.к. имеющаяся информация не позволяет причислять их к списку наиболее опасных угроз: *Akebia quinata* (Lardizabalaceae), *Araujia sericifera* (Apocynaceae), *Delairea odorata* (Asteraceae), *Cabomba caroliniana* (Cabombaceae), *Nassella neesiana*, *N. tenuissima* и *N. trichotoma* (Poaceae), *Sesbania punicea* (Fabaceae), и *Verbesina encelioides* (Asteraceae).

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Appendix

Species registered on the list of invasive or potentially invasive alien plants: emerging threats for the Mediterranean Basin

Alternanthera philoxeroides (Mart.) Griseb. (Amaranthaceae), Aligatorweed

A. philoxeroides is an emergent herbaceous, perennial herb originating from South America, found both in aquatic and terrestrial habitats. It is ranked as invasive in the USA (Buckingham *et al.*, 1983), Asia and Oceania, including Western Australia (Sainty *et al.*, 1998). Within the EPPO region, the plant is present in France (Dupont, 1984) and Italy (Ceschin *et al.*, 2006). Although it does not show clear signs of invasiveness in France, it has very recently been observed spreading on the Arno River in Firenze, see Fig. 2 (Iamonico *et al.*, 2010). Pathways for introduction are involuntary introduction through ship ballast waters (the most probable route of introduction in Australia) and through plant mulch. In France it may be present as a result of voluntary introduction as an ornamental for ponds and aquaria. *A. philoxeroides* does not produce viable seeds; spread is entirely vegetative, as stems that break off can root at the nodes and form new colonies. The fragments are dispersed by water. The plant can become a serious threat to waterways, agriculture and the environment. While invading agricultural systems, such as pastures, horticulture areas and irrigation areas, it can significantly reduce production. Moreover, mats impede the flow of water and lead to

Fig. 2 *Alternanthera philoxeroides* on the Arno river in Firenze (Italy), 2009, Photo courtesy of: L Cecchi. This figure is available in colour in the online publication.

flooding, they prevent access to and the use of water, and increase health problems by providing habitats for mosquitoes. The plant is also reported to negatively affect recreational water use (Global Invasive Species Database and the Pacific Island Ecosystem at Risk, Weber, 2003). The uncertainty for this assessment is medium.

Ambrosia artemisiifolia L. (Asteraceae), ambrosia or common ragweed

A. artemisiifolia is an annual weed 20–180 cm in height. The stem is upright, angular and well branched, flowers are light yellow and inconspicuous. *A. artemisiifolia* is native to North America and is recorded in Europe, Asia, Central and South America and Australia. The plant is most common along waterways (see Fig. 3), roads, railways and in wastelands, but can also infest crop fields, meadows, pastures, orchards, etc. *A. artemisiifolia* has a very fast and competitive growth, with a dense ground cover and is invasive in many parts of the world. It reproduces by seeds, which are produced in large numbers and remain viable in the soil for up to 40 years, depending on depth of burial in the soil (Baskin & Baskin, 1977; Hunyadi *et al.*, 2000). The seeds germinate in open, warm and well aerated soil. Fruits are locally dispersed by birds, melting snow, waterways, strong winds, by cars and machinery. The most important pathway to enter new territories is via contaminated agricultural seeds in particular bird seed, as well as forage and fodder.

Fig. 3 Plant of *Ambrosia artemisiifolia* with pollen, Pont du Gard, France, 2004. Photo: S Brunel. This figure is available in colour in the online publication.

A. artemisiifolia can have impacts on agricultural production; though its effect on crop yield depends on its density in the field, the weed control practices, their efficiency, and the crop type. Yield losses are more important in spring sown crops, than in winter crops where the weed can be effectively controlled (Chollet *et al.*, 1999; Clewis *et al.*, 2001). Indeed, *A. artemisiifolia* may cause severe problems in sunflower fields due to the botanical similarity, as effective herbicides cannot be used without damaging the crop. In addition, resistance to herbicides and the prohibition of certain of these products could significantly impede control.

Information on negative impacts of *A. artemisiifolia* on biodiversity from ecological studies in Europe is sparse. According to Pál (2004), *A. artemisiifolia* may have an effect on segetal weed associations. The main impact of this species remains on human health, as it produces allergenic pollen, which can induce allergic diseases, including asthma. Research on biological control agents is ongoing. The uncertainty for this assessment is low.

Baccharis halimifolia L. (Asteraceae), Groundseltree or Eastern Baccharis

B. halimifolia is a 4 m high shrub native to the eastern littoral of the USA, from Texas to Massachusetts. In the Mediterranean Basin, the species is recorded in France, on the Atlantic and Mediterranean coasts, and in the North-West of Spain, as well as in Belgium and the United Kingdom. It was introduced as an ornamental plant in France in 1863 and detected in Spain in the early 1940s in the Basque country (Allorge, 1941). *B. halimifolia* spreads along roadsides and the borders of waterways and can invade wastelands and different types of wet areas such as wet meadows, salt marshes and open woodlands. It is also found on cliffs (Campos *et al.*, 2004). From the age of 2, the shrub produces a large number of wind-dispersed seeds (about 1 million seeds are produced by 1 female plant in 1 season) which germinate easily (usually in 1–2 weeks) if sufficient soil moisture is available. Vegetative spread is also very effective by suckers and cuttings. *B. halimifolia* tolerates a high level of soil salinity as well as periodic floods, it can withstand many types of soil and pH, this is why it is used as an ornamental plant in coastal areas. It is frost tolerant, and can withstand temperatures as low as −15°C. The development of monospecific stands of *B. halimifolia* increases fire frequencies (Muller, 2004), reduces water availability and dries wet habitats (Rivière, 2007). It also prevents the growth of the heliophilous species typical of salt marshes, it threatens rare species such as *Matricaria maritima* and provokes a marked change in the structure, physiognomy and diversity of the community invaded (Campos *et al.*, 2004). *B. halimifolia* also impedes treatments against mosquitoes in wetlands. The uncertainty for this assessment is low.

Cortaderia selloana (Schult. & Schult. f.) Asch. & Graebn. (Poaceae), Uruguayan pampas grass

C. selloana is a perennial, robust tussock grass up to 3.5 m in diameter native to South American pampas (Argentina, Southern Brazil, and Uruguay). It has been introduced into many regions of the world as a garden plant because of its attractive flowering plumes, and also to be used for soil amendment, and windbreaks and as a dryland forage (Harradine, 1991). In many regions, including several countries in the Mediterranean Basin, *C. selloana* is considered invasive (Bossard *et al.*, 2000; Lambrinos, 2001, 2002), particularly in the South of France, in Corsica (Natali & Jeanmonod, 1996), in Italy, in Sardinia (Brundu *et al.*, 2003), in Spain and it escaped from cultivation in Canary Islands (Otto *et al.*, 2008). This species can invade wastelands, wetlands and coastal grasslands. Each plant can produce about a million viable seeds in 1 season which are dispersed by wind over dozens of kilometres (Connor & Edgar, 1974; Lambrinos, 2002). Invasion by *Cortaderia* can drastically alter ecosystem properties (e.g. flammability, diversity, food webs), as has been demonstrated for the morphologically similar *Cortaderia jubata* (Lem.) Stapf (Bossard *et al.*, 2000; Lambrinos, 2000). More specifically, in the protected coastal wetland areas of Catalonia (North-East Spain) and other parts of the country, this species has become a major conservation concern because the invasion prevents the restoration of wastelands back to wetlands where some rare or endemic species occur (Domènech *et al.*, 2005; Pausas *et al.*, 2006; Domènech & Vilà, 2007). Eradication campaigns are in progress in Spain (Zilletti *et al.*, 2008) for *C. selloana*. The uncertainty for this assessment is low. It is to be noted that *C. jubata*, not yet recorded in the Mediterranean Basin or in the EPPO region, has the potential to become a greater problem than *C. selloana* (Gosling *et al.*, 2000) because of its unusual breeding system whereby every plant can produce seed without pollination.

Eichhornia crassipes (von Martius) Solms (Pontederiaceae), Water hyacinth

E. crassipes is an aquatic plant originating from South-America. This plant is considered to be one of the most invasive plants worldwide. It particularly affects tropical areas, and is already present in all continents, but within European and Mediterranean countries, it is only established in Spain, Portugal, Italy, Israel and Syria. The plant has beautiful flowers and is imported and produced for ornamental purposes. It reproduces very efficiently vegetatively, can double its biomass in 1–3 weeks and can totally cover water surfaces. Freshwater bodies and ecosystems in the Mediterranean Basin are highly susceptible to its establishment. The species is spread rapidly through human activities; during maintenance of swimming areas, attached to fishing gear or to hulls, anchor lines, etc. It has major impacts in areas it invades: it reduces rice production (Moreira *et al.*, 2005), clogs irrigation canals (Gopal, 1987), modifies aquatic habitats leading to loss of biodiversity (Toft *et al.*, 2003), blocks hydropower generation stations and recreation areas, decreases water quality, and may increase the risk of transmission of human diseases such as malaria (Harley *et al.*, 1996). *E. crassipes* is very expensive to control. For instance, its removal along 75 km of the Guadana River in Spain between 2005 and 2008, cost more than 15 million euros (Cifuentes *et al.*, 2007). The uncertainty for this assessment is low as there is considerable bibliography on this species, including an EPPO Pest Risk Analysis and a climatic prediction performed with CLIMEX showing that the whole Mediterranean Basin is at risk (Kriticos & Brunel, in preparation). This plant is on the EPPO A2 List of pests recommended for regulation.

Fallopia baldschuanica (Regel) Holub (= Polygonum baldschuanicum Regel; Fallopia aubertii (L. Henry) Holub; Reynoutria baldschuanica (Regel) Moldenke), (Polygonaceae), Russian vine

F. balduschuanica is a perennial vine native to Central Asia. It was introduced as an ornamental plant in many countries, and it is now present and invasive in Asia and in North America (including California). Within the EPPO region, it is present in the following countries: Denmark (not invasive), Ireland (invasive), France (locally considered as invasive), Germany (not recorded as invasive), Spain (invasive, first introduction record dated 1889), Italy (invasive), Slovenia (invasive). *F. baldschuanica* can hybridize with the highly invasive *Fallopia japonica*, *which* may increase the reproductive ability of this latter very invasive plant. *F. balduschuanica* can reproduce both sexually by seeds and vegetatively by layering and rhizomes. *F. baldschuanica* thrives in disturbed sites, walls and ruins, and along riparian forests. This vine grows over shrubs and trees, and competes with native vegetation by smothering it (Sanz Elorza *et al.*, 2004). The uncertainty for this assessment is considered high as there is very little data on this species.

Hakea sericea Schrader (Proteaceae), Silky hakea

H. sericea is a shrub originating from Australia. It is invasive in South Africa. It has been voluntarily introduced for ornamental purposes, particularly to form protective hedges. Within the EPPO region it is only recorded in Mediterranean countries as it is present in France (naturalized), Portugal (invasive) and Spain (not recorded as invasive). The plant is drought, wind and cold resistant. Seeds are prolifically released after fires and are dispersed over long distances by the wind. *H. sericea* colonizes disturbed areas such as forest margins, coastal grasslands and forests. In South Africa, the dense and impenetrable thickets of this species are known to reduce native species richness, to increase fire hazards and to reduce water yields in catchments (Weber, 2003). In Portugal, the species exhibits the same invasive behaviour (Marchante & Marchante, 2005a). *H. sericea* is successfully controlled in South African rangelands by combining mechanical, chemical and biological control methods. A similar species, *Hakea salicifolia* (Vent.) B. L. Burtt is also present and invasive in Portugal and deserves attention (Marchante & Marchante, 2005b). The uncertainty for this assessment is low.

Humulus japonicus Siebold & Zucc. (= *H. scandens Lour. Merr.*) (Cannabaceae), Japanese hop

H. japonicus (Fig. 4) is an annual climber vine originating from East Asia. It is present in North America. In the EPPO region, it

Fig. 4 *Humulus japonicus*, Sainte-Anastasie, France, 2009. Photo: G Fried. This figure is available in colour in the online publication

is only recorded in France, Hungary and Italy (Celesti-Grapow *et al.*, 2009) where it showed invasive behaviour in riparian habitats and wetlands. In France, it is thought to have escaped from a garden. *H. japonicus* reproduces by seeds which are dispersed by wind and water. It can form dense stands in floodplains and along stream banks and lake shores, but can also thrive in disturbed areas such as roadsides and urban lots. In its native range (North China), the species is considered as a common weed of wheat fields, orchards and reed (*Phragmites australis*) fields (Li & Cao, 1981). This plant can be a threat to the environment when invading riparian habitats (WDAR Website, 2010). *H. japonicus* is a rapidly-growing vine that can form dense stands and displace native vegetation by out-competing with them for essential resources (Balogh & Dancza, 2008). Additionally, in Korea, China, Japan and Taiwan its pollen is considered to be highly allergenic (Kim *et al.*, 1989). The uncertainty for this assessment is high.

Ludwigia grandiflora subsp. hexapetala (Hook. & Arn.) Nesom & Kartesz. and L. peploides subsp. montevidensis (Spreng.) Raven (Onagraceae)

From their introduction at the beginning of the 19th century in the Lez River in Montpellier, the American *Ludwigia grandiflora* and *L. peploides* (Onagraceae) have progressively colonized the whole of France (Dandelot *et al.*, 2005). The identification and differentiation of these 2 species appears to be extremely complex (Dandelot *et al.*, 2005), a morphological and cytogenetic study allowed the confirmation of the presence of these 2 different taxa in France, and the absence of hybrids in the mixed zones that were monitored. The diploids (2n = 16) correspond to *L. peploides* subsp. *montevidensi*s (Spreng.) Raven, and the decaploids (2n = 10x= 80) to *L. grandiflora* subsp. *hexapetala* (Hook. & Arn.) Nesom & Kartesz. According to Dandelot *et al.* (2005), the diploids specifically colonize the Mediterranean region (except the South-Eastern part), while the polyploids predominate throughout the other regions. Both taxa exhibit an intense vegetative growth, but they have distinct breeding systems: the self-compatible diploids were always found with fertile fruits, whereas the self-incompatible polyploids were often observed as sterile. The breeding system difference could explain the substitution of *L. grandiflora* (first wave of invasion in the 19th century) by *L. peploides* in the 20th century, in the southern part of France (Dandelot *et al.*, 2005). *L. peploides* subsp. *montevidensis* was also recently recorded in Corsica (Jeanmonod & Schlüssel, 2008) and Greece (Zotos *et al.*, 2006). According to Galasso (2007). In Italy, *L. grandiflora* is not considered as present as some historical records were probably misidentified, while *L. peploides* subsp. *montevidensis* and *L. grandiflora* subsp. *hexapetala* or present in the Northern regions and are regarded as potentially invasive. The rapid and extensive development of plant populations can block waterways (and thus disturb many human activities such as navigation, hunting, fishing, irrigation and drainage), reduce biodiversity and degrade water quality. Studies in France have shown that *Ludwigia* species were able to produce rapidly a high biomass (up to 2 kg of dry matter per m^2). Biomass could double in 15–20 days in slow-flowing waters and in 70 days in rivers. As an example, populations of *Ludwigia* spp. in Marais d'Orx (France) occupied a few m^2 in 1993 and reached 130 ha in 1998. These species are also invasive in California (Okada *et al.*, 2008). Control is very difficult (mechanical control is possible but care should be taken not to produce more fragments which may disseminate the plants further, herbicides are available but their use in the natural environment is difficult). The uncertainty for this assessment is low.

Hydrilla verticillata L. F. Royle (Hydrocharitaceae), Florida elodea

H. verticillata is a submerged freshwater aquatic perennial with heavily branched stems towards the water surface. Stems can grow up to 9 m long. There are both monoecious and dioecious forms, with small white female flowers and small, green male flowers. *H. verticillata* is usually rooted to the substrate but can also grow as floating mats at the surface. Originating from Asia and Northern Australia, it has been introduced into all 5 continents as an aquarium plant, where it is considered invasive. In the EPPO region, it is present in Ireland, Latvia, Lithuania, Poland and Russia. The plant was found in 1914 in 1 place in Great Britain but is believed to have become extinct. It is still found in 1 location in Ireland, but it is declining there. In Austria, it is recorded as casual from a hot spring in Carinthia (Essl & Rabitsch, 2002). In Germany, *H. verticillata* was found around 100 years ago, but there are no recently known occurrences. The plant reproduces mainly by regrowth of stem fragments (even small ones, i.e. 2.5 cm); most populations do not set any seeds. It produces turions of 0.6 cm at the axils of leaves and potato-like tubers attached to the roots. The turions break off the stems and can drift for long distances before sinking to start a new plant. Tubers may remain viable for 4–7 years in the sediments and 1 tuber can lead to the production of 5000 new tubers per square metre. Tubers and turions can survive ice cover, drying, ingestion and regurgitation by waterfowl. Fragments, tubers and turions are spread by water currents and wildfowl. *H. verticillata* grows rapidly and can double its biomass every 2 weeks in summer conditions. It is found in freshwaters (springs, lakes, marshes, ditches, rivers) but can tolerate salinity (Twilley & Barko, 1990). The plant is winter-hardy, but prefers temperatures between 20 and

27°C; its maximum temperature is 30°C (Kasselmann, 1995). It forms dense mats on the water surface, reducing plant and animal abundance and diversity. The dense mats also affect recreational activities. *H. verticillata* can slow down or clog rivers, irrigation ditches, and flood control canals. Biological control agents include Chinese grass carp (*Ctenopharyngodon idella*), but these should be used with great caution since grass carp is not selective and might feed on native plants as well, and become invasive itself. An integrated approach including biological control with Chinese grass carp, mechanical and manual methods has been found successful (University of Florida, 2009). The uncertainty for this assessment is medium.

Microstegium vimineum (Trin.) A. Camus. (Poaceae)

M. vimineum is an annual grass resembling a small bamboo. The plant produces a sparse, very short root system. It is usually 0.6–1 m in height, and the reclining stems can grow up to 1 m long. Native to Asia, it has been introduced into Central and North America. It has also been introduced into Turkey where it is considered alien (Scholz & Byfield, 2000), but it is not recorded whether it is casual or naturalized there. It is also present in Russia in the region of Primorsk, where it is probably native. Within the EPPO region, its distribution is still limited. The plant reproduces vegetatively by rooting at nodes. Sexually, it can produce 100 to 1000 seeds per plant, which are dispersed by water, animals, and through human activities. It can also be introduced as a contaminant of bird seeds, soil and hay. Seeds may remain viable for 5 years in soil. It grows on early successional fields, forested slopes, banks of continental water, forested wetlands, roadsides, wastelands, green urban areas. The coldest winter temperature at which invasive populations occur is approximately −21 to −23°C. *M. vimineum* is able to invade wild habitats and to replace natural communities rapidly with nearly monospecific stands (Tu, 2000). Once established, it can overgrow herbaceous vegetation in wetlands and forests within 3–5 years. Populations of *M. vimineum* alter quality nesting for wildlife (e.g. quails) and create suitable habitats for rats. Hand pulling is the preferred method of removal (highly specific and minimal impact, although labour intensive and time consuming) if undertaken before seed release (late summer), but mowing before seed production can be effective as well. Cattle, deer and goats do not feed on the plant, so grazing is not indicated. Spring burns are ineffective since seeds will germinate afterwards, but burns in the late autumn may control the species. Large patches can be sprayed with grass-selective herbicides (GISD, 2005a). The uncertainty for this assessment is medium.

Myriophyllum heterophyllum Michx. (Haloragaceae), variable watermilfoil

M. heterophyllum is an aquatic perennial plant native to the South-East of the USA. It is considered invasive in much of the North-East of the USA. In the EPPO region, it has been found in Austria, Germany, Spain (O Mayoral, pers. comm. 2006), and the Netherlands where it is potentially invasive. The species is used in aquaria and for ornamental purposes in ponds. Reproduction occurs primarily through vegetative fragmentation and rhizome division, although the plant may also reproduce by seeds, which remain in lake and pond sediments. *M. heterophyllum* over-winters in the frozen lakes of northern climates and can thrive in warm southern water bodies. It has also been found growing under a wide range of water temperatures and chemical conditions: it can be found calcium-rich waters, but tends to prefer acid pH waters. Vegetative parts of the plant may be spread by animals and human activities (e.g. fishing, movement of boats). Waterfowl can also facilitate the spread of the plant by eating seeds. Suitable habitats for this species include freshwater ponds, lakes, ditches, standing and slow flowing waters, where it can produce dense mats that reduce sunlight and restrict water movement. When the plant decomposes, water quality and available oxygen may be reduced. The low oxygen conditions can kill fish and harm other aquatic organisms. The dense mats can impede swimming, boating and fishing. Moreover, dense mats along lake shorelines have been reported to reduce property values by 20–40%. In Eastern USA, the species may hybridize with the native *M. pinnatum*, resulting in a more aggressive hybrid *Myriophyllum heterophyllum x pinnatum*. (Robinson, 2002; Hussner, 2005). The uncertainty for this assessment is high.

Pennisetum setaceum (Forssk.) Chiov. (Poaceae), fountain grass

P. setaceum (Fig. 5) is a C-4 grass native to the Sahara Desert and arid coasts in Northern Africa (e.g. Algeria, Morocco, Tunisia) and the Middle East (e.g. Israel). The species is present and still spreading in France (including Corsica), in Italy (including Sardinia and Sicilia), and in Spain (including Balearic Islands and Canary Islands) (Brundu *et al.*, 2003). Specifically in Sicilia, *P. setaceum* is found in seminatural habitats (D'Amico & Gianc-

Fig. 5 *Pennisetum setaceum*, Kamieskroon, Namaqualand National Park (South Africa), 2009. Photo: G Fried. This figure is available in colour in the online publication.

uzzi, 2006) and a new plant community (association) has been described, namely *Penniseto setacei–Hyparrhenietum hirtae* (Giancuzzi *et al.*, 1996).

P. setaceum reproduces by seeds. The spikelets have bristles, and are spread in late spring by wind, water, human activities, and by sticking to animals. Seeds can survive in the soil for as long as 7 years, and individual plants may live up to 20 years or more (Donaldson & Rafferty, Undated). This species is described as a poor pasture species and is considered a serious weed in many dry habitats. It is a very aggressive plant forming monospecific stands and out competing native plants by reducing available space and taking scarse water and nutrients. It also raises fuel loads, and becomes extremely flammable in winter, increasing the intensity and spread of fire, resulting in severe damage to native dry forest species adapted to less extreme fire regimes. Fires that follow invasions affect ground nesting birds and terrestrial animals and have the ability to change the structure of deserts. In Hawaii, *P. setaceum* dominates areas that formerly supported native *Heteropogon contortus* (Poaceae).

P. setaceum is sold by retail nurseries for use in ornamental landscapes, and is sometimes planted for bank stabilization along roads. While the nursery varieties are said to be sterile, there is no clear evidence that this is true. Several varieties of *Pennisetum setaceum* may be sold, ranging in colour from reddish to rose or purple. All cultivars are considered invasive and should not be sold or planted (Donaldson & Rafferty, Undated). The long-lived seeds of fountain grass make its control extremely difficult. Small infestations may be managed by uprooting plants by hand and destroying the inflorescences in order to prevent seed dispersal. Removal by hand may need to be repeated several times per year. Extensive infestations of fountain grass are probably best controlled with the help of herbicides, especially those with some systemic activity (PCA, 2005). The uncertainty for this assessment is medium.

Pistia stratiotes L. (Araceae), Water lettuce

P. stratiotes is an aquatic plant originating from South America. The species is present and invasive in the USA (including California), in Australia (including Western Australia), in Swaziland and in Asia. Within the Mediterranean Basin, it is only recorded as established in the Canary Islands where it is considered invasive (V. E. Martin Osoria & W. Wildpret, pers. comm., 2005). In recent years, episodic records have been reported in several water bodies of the South West of France (Dutartre *et al.*, 2009). In 2003, favourable climatic conditions allowed *P. stratiotes* to cover 500 m of a stream near Bordeaux which required a mechanical removal to reduce impacts. It has also been observed in a pond and on a river in the Mediterranean part of France (Gard Department). This species has been observed as casual in the North of Italy (Celesti-Grapow *et al.*, 2009), in Moscow (Schanzer *et al.*, 2003 in Sajna *et al.*, 2007) and it is reported to survive in a thermal stream in Slovenia (Sajna *et al.*, 2007). It is extensively traded for ornamental and aquarium purposes. The most commonly accepted pathway of this species into the USA is in ballast water released by ships from South America. The plant is thought to spread via dumping of aquarium materials or escapees from ornamental ponds. Water lettuce reproduces both by seeds and vegetatively and occurs in lakes, water courses and wetlands.

Rapid vegetative reproduction allows water lettuce to cover an entire lake, from shore to shore, with a dense mat of connected rosettes within a short period of time. Dense mats can have a negative economic effect by the blocking waterways, thus increasing the difficulty of navigation and hindering flood control efforts. They can also lead to a lower concentration of oxygen in covered waters and sediments by blocking air-water interface and root respiration. The cumulative effect of these negative characteristics of the plant is a loss of biodiversity in invaded habitats. *P. stratiotes* mats can also serve as a breeding place for mosquitoes (Global Invasive Species Database, the Pacific Island Ecosystem at Risk). The uncertainty for this assessment is medium, as the species may greatly be limited by cold temperatures.

Salvinia molesta D. S. Mitch. (Salviniaceae), Giant Salvinia

S. molesta is a floating aquatic fern originating from South-America, more precisely in South-Eastern Brazil (Julien *et al.*, 2002). Within the EPPO region the plant is so far only recorded in Italy (Giovannini *et al.*, 2001; Giardini, 2006) and in Portugal (1 locality – Odemira – in Algarve; Garcia, 2008). It is invasive in Africa (including South-Africa), Asia, the Southern USA (including California), and Oceania (including Western Australia). The plant is traded as an aquatic ornamental plant, as well as an aquarium plant. It is thought that many infestations have arisen from discarded aquarium material.

S. molesta prefers tropical, sub-tropical or warm temperate areas of the world. Depending on the climate, it can either be an annual (in non-tropical regions) or a perennial. The plant only reproduces vegetatively and is dispersed by wind and water. Vegetative parts of the plant may be spread by human activities such as fishing or movement of boats. *S. molesta* reduces oxygen diffusion into the water, reducing the quality of the habitat for flora and fauna. Native aquatic plants are eliminated; dead plants release large amounts of nutrients into the water, thereby increasing euthrophication. In the Kakadu national park (Australia), bird species that used open waters declined in areas that were heavily infested. Small fish and snake abundance was also reduced. In India and on the islands of Borneo and Sri Lanka, the plant is harmful to fisheries and is also a serious weed in ricelands. It blocks irrigation channels and makes fluvial transport more difficult. It may also provide a breeding ground for mosquitoes, which are vectors of diseases (malaria in Sri Lanka, encephalitis in Australia) (Global Invasive Species Database and the Pacific Island Ecosystem at Risk, Weber, 2003). The uncertainty for this assessment is medium.

Solanum elaeagnifolium Cav. (Solanaceae), Silver-leaf night shade

S. elaeagnifolium (Fig. 6) originates from South America and is a weed of many crops: maize, cotton, potato, tomato, cereals, orchards, etc. The species is present on all 5 continents where it is considered a severe threat. *S. elaeganifolium* is already invasive in North Africa (Morocco, Tunisia, Algeria), more recently in Syria (Al Mouemar & Azmeh, 2009), and is also present, but

Fig. 6 *Solanum elaeagnifolium*, Vic-la-Gardiole, France, 2008.
Photo: G Fried. This figure is available in colour in the online publication.

not always considered as invasive in Croatia, France, Greece, Israel, Italy, Serbia, Spain, etc. although this may change over time. The species could spread to further countries of the Mediterranean Basin as a contaminant of a variety of commodities: seeds for sowing, grain, plants for planting accompanied by soil, etc. The plant reproduces very efficiently vegetatively, as fragments of roots as small as 0.5 cm long can regenerate. Fifteen hundred to 7200 highly viable seeds are produced per plant and can remain viable for at least 10 years. Spread is extremelly efficient via livestock and manure, irrigation water, agricultural machinery and vehicles, rooted nursery plants, contaminated straw or seeds, as well as by wind over dozens of kilometers (Taleb & Bouhache, 2006). This plant causes serious crop losses in alfalfa, cotton, sorghum, maize, groundnut, wheat and cultivated pastures, which can decrease livestock production. In Morocco, for instance, losses of up to 47% in maize and 78% in cotton have been reported (Baye & Bouhache, 2007). Agricultural land infested with *S. elaeagnifolium* loses considerable rental and resale value. In Morocco, the value of infested land decreased by 25% (Gmira *et al.*, 1998). Following a joint EPPO and Food and Agriculture Organization (FAO) workshop in Tunisia in 2006 on this species, a management program has been implemented for North Africa. The uncertainty for this assessment is low, an EPPO PRA is available and this species is recommended for regulation by EPPO.

Species registered on the observation list

Akebia quinata Decne. (Lardizabalaceae), Chocolate Vine

A. quinata is a woody perennial plant which climbs on shrubs and trees up to 20 m (usually between 7 and 15 m), or forms groundcover. It originates from Central China, Japan and Korea. Within the EPPO region the species has a very limited distribution, with a few established populations in the South-West of France (Vivant, 2008), in the UK and 2 records in Ticino in Switzerland. *A. quinata* spreads primarily by vegetative means. Birds are also suspected to play a role in its dispersal but the production of seeds has to be checked in the EPPO region since in the mid-Atlantic region of North America, fruits are not always produced (Swearingen *et al.*, 2006). *A. quinata* is shade and drought tolerant, enabling it to potentially invade many types of habitats. Nevertheless, it prefers light, well drained soils and sunny to partially shaded environments. In France, the plant invades riparian habitats (Vivant, 2008) but impacts remain to be precisely assessed. In Switzerland, while the species has been naturalized for many years, no noticeable spread and invasiveness has been reported (Serge Buholzer, pers. comm., 2010) In North-Eastern USA, *A. quinata* forms dense curtains of interwined stems that cover, out compete and kill existing ground level herbs and seedlings, understorey shrubs and young trees, and overtop canopy trees. Once established, the plant prevents germination and establishment of native species (Weber, 2003; GISD, 2005b). The uncertainty for this species is high.

Araujia sericifera Brotero (Apocynaceae), Cruel plant

A. sericifera is a perennial evergreen climber with twining stems, climbing up to 6 m on vegetation, native to South America. The species is invasive in South Africa, California and Australia. Within the EPPO region, the species is established in France (including Corsica), Greece, Israel, Italy, Portugal (Azores, Madeira), and Spain. The plant was introduced during the 19th century as an ornamental and textile plant. The large quantities of seeds produced are viable for at least 5 years. Seeds are thought to be dispersed by the wind and by water.

The vine colonizes river banks, forests, crops, urban areas (e.g. roadsides) and wastelands where it grows vigorously. It has dense foliage that smothers native shrubs and trees. Dense infestations might form an obstacle to the regeneration of native species. Additionally, the sap of the plant is poisonous and causes skin irritation (Sanz Elorza *et al.*, 2004). Indeed, the common name of *A. serificera* is 'Cruel plant', as moths, bees and butterflies are often trapped and killed by the secretion within the flowers. Nevertheless, although present for a few decades in Italy, no impacts on the environment were explicitly recorded, and this species is only considered a general agricultural weed (Celesti-Grapow *et al.*, 2009). The overall uncertainty for this assessment is medium.

Delairea odorata Lem. (= Senecio mikanioides Otto ex Walp.), (Asteraceae), Cape ivy or German ivy

D. odorata is a perennial, evergreen vine that is native to South Africa. Although its native range is fairly limited, *D. odorata* can tolerate a wide range of environmental and habitat conditions (GISD, 2010), and it is described as a serious pest along the coasts of California, in Oregon, Hawaii (on the island of Maui), in Australia and in New Zealand (Alvarez, 1997; Robison, 2006; GISD, 2010). This vine is usually introduced as an ornamental groundcover. Within the EPPO region it is recorded in several Italian regions including Sardinia (only as a casual) (Celesti-Grapow *et al.*, 2009). It is recorded in Croatia, France, Ireland, Italy, Portugal, UK, Spain, including Canary Islands, where control is considered worthwhile. (Gallo *et al.*, 2008).

D. odorata spreads prolifically by vegetative reproduction through stolons or stolon fragments, and seeds are dispersed by

wind and water. Dumped garden waste, containing seeds and stem pieces, contributes to its spread (Northcote City Council & Duggan, 1994). Long distance dispersal is currently mostly by humans spreading the plant in landscaping.

D. odorata can invade different habitats ranging from disturbed to natural and occurs in both dry to moist conditions. It can form dense vegetative groundcover mats that can prevent seeding of native plants. It can also smother native vegetation and affect regeneration, forming stands of over 75% cover and competing with other plants for water and nutrients. Native plant species richness can be reduced about 50 percent, with greater impact on annual than on woody perennial species. The weight of large masses of climbing vines can bring down trees. Higher trophic levels can also be affected, such as several sensitive species of insects and predators. Furthermore, flood control function along streams is impacted by *D. odorata*. In riparian communities, *D. odorata* can increase soil erosion along watercourses due to its shallow root system not capable of holding soil. *D. odorata* also contains substances toxic to humans, mammals, and particularly to aquatic organisms, decreasing survival of fish and aquatic insects. When the plant is present in pastures, it also reduces forage quality (Weber, 2003; GISD, 2007). The uncertainty for this assessment is medium.

Cabomba caroliniana A. Gray (Cabombaceae), Green cabomba

C. caroliniana is a fully submerged, perennial freshwater plant originating from South America. The species is used as an aquarium plant, and its main pathway of entry is supposed to be its release into the wild via aquaria dumping. This plant has been described as out-competing native aquatic vegetation (Wilson & Watler, 2001), clogging waterways, speeding up natural successions, and obstructing recreation activities (boating, fishing and swimming) in the US, Canada and Australia, countries where it is considered invasive.

In the EPPO region, the invasive behaviour of this species has not been clearly stated. The plant was recorded but disappeared from sites in Scotland (T. Rotteveel, pers. comm., 2008) and England (Preston *et al.*, 2002). Even if present in England since 1969, it did not spread or become invasive there, nor in Belgium and Hungary. The plant has recently been found in France in the Canal de Bourgogne and in the Canal du Midi, but the species does not exhibit invasive behaviour yet (Dutartre *et al.*, 2006; Enjalbal, 2009). In the Netherlands, it spread and became problematic in 1 site out of the 3 sites where it was found.

An EPPO PRA has been performed on this species which was unable to clearly conclude on the invasive potential of this species. The uncertainty for this assessment is medium as experiments are still in progress to understand why the species is invasive in some situations and not in others.

Nassella neesiana (Trin. & Rupr.) Barkworth, Chilean needle grass, *N. tenuissima (Trin.) Barkworth*, Mexican feather grass and *N. trichotoma (Nees) Hack.*, Serrated tussock (Poaceae)

N. neesiana, *N. tenuissima* and *N. trichotoma* are perennial tussock-forming grasses native to South and Central America. They can reach 0.6 m (*N. trichotoma*) to 1 m high (*N. neesiana*). All 3 species are considered invasive in Australia. These 3 grasses are established in the South of France (including Corsica), *N. neesiana* is recorded in Spain, and *N. trichotoma* and *N. tenuissima* are established in Italy. Within these countries, no impacts have been observed to date. The potential spread of these plants should however be monitored since a rapid extension has been noticed along roadsides locally in the South of France (Verloove & Vandenberghe, 2002). Mature plants produce a large number of seeds (20 000 for *N. neesiana* to 140 000 for *N. trichotoma*) that can be blown by wind over very long distances (up to 20 km). Seeds readily adhere to clothing and livestock. They can also be dispersed on farm machinery, or as a contaminant of seeds and fodder. In Australia, where these plants invade pastures, native (but disturbed) grasslands, grassy woodlands and roadsides, *N. trichotoma* and *N. neesiana* are considered as Weeds of National Significance (see the website Weeds Australia) as they reduce biodiversity in native grasslands by out competing indigenous species (Sheehan, 2003). However, these grasses mainly cause problems in grazing lands with poor soil fertility and low rainfall, where the benefits of control are marginal. Infestations result in a significant loss in livestock production (up to 95% loss), and dense infestations may completely dominate pastures, making large areas incapable of supporting livestock (*Nassella* spp. have no grazing value because of high fibre and low protein content). The risk of these agricultural impacts may be lower within the Mediterranean Basin since the kinds of pastures and landscape use in livestock production areas are different. The environmental risk must however be kept in mind with potential impacts on Mediterranean dry grasslands. The uncertainty for this assessment is medium.

Sesbania punicea (Cav.) Benth. (Fabaceae), Rattle box or Ruttle bush

S. punicea is a deciduous shrub or treelet reaching 4 m in height, with very attractive orange-red flowers in hanging clusters (Fig. 7). It originates from South America and has been introduced worldwide as an ornamental plant. It is considered invasive in the USA (particularly in California and Florida), in South Africa, and in Queensland (Australia). Within the EPPO region, it is recorded as recently naturalized in the islands of Sicilia,

Fig. 7 *Sesbania punicea* in Sardinia, 2009, Photo: G. Brundu. This figure is available in colour in the online publication.

Sardinia (Brundu *et al.*, 2003) and also in Corsica where it is recorded as invasive in riparian habitats (Natali & Jeanmonod, 1996).

S. punicea reproduces by seeds, and hundreds of pods are released around the base of the parent plants. Pods may fall directly into rivers, floating kilometers downstream to start new populations, and can also be spread with soil. Dry pods contain impermeable seeds that do not swell when kept in water for over 1 year (Bevilacqua *et al.*, 1987). Seeds are not spread by animals as they are toxic. *In the invaded riparian habitats*, *S. punicea* can rapidly form dense stands and completely cover areas of up to several thousands square meters. In these habitats it may displace native plant species that provide essential food and shelter for a wide variety of wildlife species. *S. punicea* contains saponine which is toxic to both humans and animals (birds, reptiles and mammals). Stands formed by *S. punicea* are often so thick that access to rivers becomes difficult. Tall stands can also reduce water flow and flood conveyance in rivers, contributing to erosion (Brusati, 2005; The Nature Conservancy Website). Since the 1990s, biological control agents have been released in South Africa to control *S. punicea*. The reproductive potential of this species has been markedly reduced throughout South Africa by the release of *Trichapion lativentre* (Coleoptera: Apionidae) and, to a lesser extent, by *Rhyssomatus marginatus* (Coleoptera: Curculionidae). (Hoffmann & Moran, 1991, 1999). The uncertainty for this assessment is low.

Verbesina encelioides (Asteraceae), Golden crownbeard

V. encelioides (Fig. 8) is an erect annual native to the Americas. It naturalized in India, Saudi Arabia, Southern Africa and in Australia. Within the EPPO region, it is known to be invasive in Israel and Morocco. It is also recorded in Spain, (O García-Berlanga & M Gómez-Serrano, pers. comm., 2005), Denmark and the United Kingdom but its status is unknown there. The pathways of introduction of this species remain uncertain but are generally considered to be unintentional, as a contaminant of soil, of wool, of equipment, of pasture hay and cereal grain. In some cases, *V. encelioides* has also been introduced as an ornamental plant and for landscaping use due to its low water requirements. A single flower head produces 300 to 350 seeds and each plant can produce 2 to 6 flowers leading to the production of 600 to 2100 seeds per plant. Seeds are dispersed under or nearby the parent plant, or by light winds. Additionally, seeds can travel long distances by adhering to wool, fur, clothing, sacks and other fibrous material. *V. encelioides*' range can encompass a variety of habitats, temperatures, and elevations.

Fig. 8 *Verbesina encelioides* on a road side, Israel, 2008. Photo: S Brunel. This figure is available in colour in the online publication.

Arable land (fields of peanut, millet, maize, rice, barley, vegetables, orchards), pasture and disturbed habitats appear to be ideal habitats for the plant. *V. encelioides* is therefore a weed of maize, barley, rice, peanut and millet fields (one of the most common crops in Northern India). The plant contains a toxic component called galegine which poisons livestock (sheep). In Morocco, the plant is also reported to be a host of whiteflies such as *Bemisia tabaci* (Hemiptera: Aleyrodidae, EPPO A2 List) and *Trialeurodes vaporariorum* (Hemiptera: Aleyrodidae) (Taleb & Bouhache, 2006). *V. encelioides* displays allelopathic effects inhibiting native plants growth. Its aggressive and dominant growth abilities out compete native plants (Shluker, 1999). The uncertainty for this assessment is medium.

Species of less concern

Alternanthera pungens Kunth (Amaranthaceae)

A. pungens is a prostrate herb considered to be a weed of warm temperate and tropical areas around the world. This species originates from South-America and is now present in all 5 continents. Within the EPPO region, the species is naturalized in Spain, it colonizes citrus orchards and summer crops in the East of Spain, but is not regarded as an important weed (J Recasens, pers. comm. 2009). In Israel, the species was recorded in the Northern Negev in wet places and was mentioned as 'very rare (casual)' by Zohary, 1966;. It has not been found in Israel since this record (A. Danin, pers. comm., 2008). In Belgium, the species was introduced as a wool contaminant in 1949 but did not naturalize (Verloove, 2006). This species could spread within the Mediterranean area of the EPPO region, but considering its various failures in establishing, it is not considered as a major risk. The uncertainty for this species is low.

Cotula coronopifolia L. (Asteraceae)

C. coronopifolia (Fig. 9) originates in South-Africa and Namibia. It behaves either as an annual dying during the first autumn frosts (e.g. in Europe), or as a perennial under subtropical conditions. It is present in North America, South-America, Australia, New Zealand. It is present in many countries within the EPPO region: Belgium, Denmark, France (including Corsica), Germany, Greece, Italy (including Sardinia), the Netherlands, Norway, Portugal,

Fig. 9 *Cotula coronopifolia* Albitreccia, South Corsica, 2010. Photo: G. Fried. This figure is available in colour in the online publication.

Spain (including Balearic Islands), Sweden and the United Kingdom. However signs of invasiveness have only been recorded in Corsica, Sardinia (wetlands) and Spain.

The species has been voluntarily introduced for ornamental purposes or for revegetation in many countries, and is also though to have been introduced as a contaminant, probably in sediments and ballast waters. Although stems can produce roots at the nodes, allowing the plant to reproduce vegetatively, the spread of this plant appears to be relatively slow in California. Additionally, the plant is considered to be able to build up dense populations that crowd out native vegetation, but in California, the state wide impact of *C. coronopifolia* was assessed to be limited by the California Invasive Plant Council (Cal-IPC). Considering the wide distribution of this species in the EPPO region, and the limited impacts reported so far, this species is not considered as a priority for action. The uncertainty for this species is medium.

*Eichhornia azurea (Sw.) Kunth (*Pontederiaceae), Anchored water hyacinth

E. azurea originates from South America and has been introduced in a few countries in Asia (India, Iran, Singapore). The species is registered on the noxious weed list in the USA, and a population was eradicated from Florida. The species is usually introduced for ornamental purposes, and being a congeneric species of the very invasive *Eichhornia crassipes* calls for caution. In French Guyana, the plant is recorded as a weed in canals (P. Marnotte, CIRAD, pers. comm., 2008). Nevertheless, when investigating on this species, few impacts were recorded, and it appeared that it does not have the same invasive potential as *E. crassipes*. This species does not seem to present a huge risk for the Mediterranean area though it was able to establish everywhere it has been introduced. An EPPO Pest Risk Assessment is currently in progress. The uncertainty for this species is medium.