Gymnocoronis spilanthoides *is a fast-growing plant from the (sub) tropical swamps from Mexico to Argentina. © Tim Adriaens, INBOB.*

The management of Senegal tea plant (*Gymnocoronis spilanthoides*)

Measures and associated costs

Scientific name(s)	*Gymnocoronis spilanthoides* (D.Don ex Hook. & Arn.) DC.
Common names (in English)	Senegal tea plant
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Common names

BG	–
HR	Senegalski čaj
CZ	–
DA	Senegal teplante
NL	Smalle theeplant
EN	Senegal tea plant
ET	Rändav vesipäsmas
FI	Brasilianvesiasteri
FR	Faux hygrophile
DE	Falscher Wasserfreund
EL	–
HU	Mexikói vízibojt
IE	Planda tae Seineagálach
IT	Palla di neve
LV	Senegāla Tēja
LT	–
MT	It-te tas-Senegal
PL	Gymnokoronis dębolistny
PT	Tuna
RO	–
SK	–
SL	Ozkolistni gimnokoronis
ES	Jazmín de bañado
SV	Vattenflockel

Summary of the measures, emphasizing the most cost-effective options.

Gymnocoronis spilanthoides is a perennial emergent aquatic or wetland herb, which can also grow in a submerged form. The native range of the species is South America, mostly centred around Uruguay and Paraguay. In Europe it has been reported from thermal waters in Hungary and in an irrigation system in northern Italy, and according to the species risk assessment (EPPO, 2016) within Europe the species is a high risk to countries bordering the Adriatic Sea. Within its native range, *G. spilanthoides* is reported as a principal weed in Argentina. The species is problematic in Australia, New Zealand, Japan, China and Taiwan and has recently naturalised in Italy (EPPO, 2016).

As the species is found within the aquarium trade, banning its import and sale would be an effective preventative measure. In addition, public awareness campaigns in countries where the species is already established, and in countries at risk targeting botanic gardens, should reduce the risk of unintentional introduction and further spread of the species. The control of the species poses challenges once it has become established. Therefore, to prevent introductions in unaffected MSs or further spread into the areas where this species is not yet present, it is important to act at the earliest stage of invasion and to prevent additional introductions and further spread in those areas in which it is already present so as to avoid costs linked to managing the species when widely established. Containment and control are likely to be costly, which reinforces the need for preventive action in the area at risk.

Early detection and rapid eradication are critical for limiting the spread of invasive aquatic plants. Early detection could be achieved by incorporating the species in a more comprehensive citizen-science IAS monitoring system in combination with a general public awareness campaign. Rapid response to control small scale infestations already reported in the EU is essential.

As with most other invasive alien species, the best way to deal with the threat posed by *Gymnocoronis spilanthoides* to biodiversity and society is through a combination of preventative measures, early detection and rapid response to new incursions, with permanent management only as the last option. Total eradication after extensive establishment is unlikely. It is advised that a prohibition on imports, sale, transport, exchanges, breeding and release of this species will prevent its wider establishment in more EU Member States (MSs). As the area at risk is only a small part of the EU, national measures by the MSs at risk might be an alternative option.

Physical removal of small patches may be successful through careful and thorough hand-pulling and uprooting the plants. Exclusively mechanical control options on *G. spilanthoides* have not been studied in detail yet.

The main knowledge gap is in biological control. A host-specific biological control candidate for this species should be found.

Measures for preventing the species being introduced, intentionally and unintentionally.

This section assumes that the species is not currently present in a Member State, or part of a Member State's territory.

A ban on importing (pre-border measure), selling, breeding, transporting, exchanging and releasing *G. spilanthoides.*

MEASURE DESCRIPTION

Prohibition of import, sale, transport, exchange, breeding and release of this species will prevent its wider establishment across the EU. International trade in aquarium plants is the only realistic introduction pathway identified for the species (EPPO 2016).

EFFECTIVENESS OF MEASURE

This measure has been shown to be effective in New Zealand. *Gymnocoronis spilanthoides* is listed in the National Pest Plant Accord (NPPA), a cooperative agreement between central government agencies, local government agencies and the Nursery and Garden Industry Association. Species on this list are legally prohibited from sale, propagation and distribution under provision of the Biosecurity Act. All commercial nurseries, pet and aquarium shops are regularly inspected by officers warranted under the Biosecurity Act to ensure compliance (Champion *et al*., 2014). This measure, combined with removal from sites, has resulted in the species being eradicated from most known sites (Champion and Clayton, 2003).

EFFORT REQUIRED

As the species at present has an extremely limited distribution in the wild in the EU, the measure is likely to have results quickly if combined with rapid eradication of the known infestations. In general, considerable effort is needed to train staff, develop identification tools for border control and communicate the measures to stakeholders and the general public.

RESOURCES REQUIRED

This is difficult to estimate and will vary between MSs. No published data are available.

SIDE EFFECTS

None known.

ACCEPTABILITY TO STAKEHOLDERS

Banning the trade would have an impact on the trade of aquarium plants. In the UK alone in 2015 ca. 75,000 plants were sold valuing over GBP 100,000 (OATA, pers. comm., 2016). Import data for the Netherlands amounted to less than 1,000 units in 2006 (Brunel, 2009). In addition to that the majority of plants in trade are produced within the EU (van Valkenburg, pers. comm.). Alternative species are available.

The area at risk for invasion in the EU at present is limited to the countries bordering the Adriatic Sea. With projected climate change areas in the Atlantic zone of Portugal, Spain and France would become potentially suitable (EPPO, 2016).

ADDITIONAL COST INFORMATION

None known.

LEVEL OF CONFIDENCE[1]

High.

Published information from New Zealand points to the feasibility if combined with concerted rapid response actions.

1 See Appendix

Public awareness raising campaigns.

MEASURE DESCRIPTION

Public awareness campaigns in countries where the species is already established, and in countries that are at a high risk, those bordering the Adriatic Sea, could help prevent unintentional introductions, and spread of the species. The species, once established, can spread through the transport of seeds or stem fragments of less than 1 cm length to new areas via human activities or downstream through flooding events (EPPO, 2016).

Key target groups of awareness campaigns would be recreational users of waterways (boating, fishing etc.), and aquarium enthusiasts and botanic gardens in those countries at risk where the species is not yet established in the wild. In reality the campaigns would incorporate other aquatic invasive species that are introduced and spread along the same pathways.

EFFECTIVENESS OF MEASURE

It is important to note that these preventative measures should be implemented by all countries that are at risk, as the species could spread from one country to another (EPPO, 2016).

An example of public awareness campaigns within the EU is the LIFE ASAP (Alien Species Awareness Programme) project http://www.lifeasap.eu/it) which began in 2016 and is running until 2020, and aims to limit the spread and impact of IAS in Italy through public awareness and participation. In the UK, there are also the *Be Plant Wise* campaign (http://www.nonnativespecies.org/beplantwise/index.cfm) which aims to raise awareness among gardeners, pond owners and retailers of the damage caused by invasive aquatic plants and to encourage the public to dispose of these plants correctly; and the *Check Clean Dry* campaign (http://www.nonnativespecies.org/checkcleandry/index.cfm) that aims to stop the spread of invasive plants and animal in British water through awareness raising with key stakeholder groups.

The plant grows 30-60 cm high. © Tim Adriaens, INBO.

There is limited evidence regarding awareness campaigns effectiveness for invasive species, however in a study focusing on the Broads wetlands in the UK (Burchnall, 2013), the Check Clean Dry campaign led to a 9% increase in the numbers of general public following the recommended biosecurity procedures, and 14% increase in high risk user compliance. Another UK study (Anderson *et al.*, 2014) found that anglers and canoeists who had heard of the Check Clean Dry campaign exhibited biosecurity hazard scores that were 40% lower than those who had not.

EFFORT REQUIRED

Awareness campaigns would need to be run in the long term.

RESOURCES REQUIRED

Resources required to run an awareness campaign could vary greatly on the stakeholders to be engaged with. For example, websites, printed material, staff costs, publicity events and stakeholder engagement meetings may all be needed. The costs of running the UK Check Clean Dry campaign is currently around £50,000/year (Booy, pers. comm.).

SIDE EFFECTS

Public awareness campaigns would incorporate other aquatic invasive species that are introduced and spread along the same pathways.

ACCEPTABILITY TO STAKEHOLDERS

Public awareness campaigns should be acceptable to all stakeholder groups.

ADDITIONAL COST INFORMATION

No information.

LEVEL OF CONFIDENCE[1]

High.

Public awareness campaigns have been successfully run on invasive species across the EU and around the world.

1 See Appendix

Measures for early detection of the species and to run an effective surveillance system to detect efficiently new occurrences.

Citizen-science combined with a national coordinating body.

MEASURE DESCRIPTION

The early detection of invasive alien aquatic plant species is a key factor in the successful eradication of new infestations (Genovesi *et al.*, 2010; Hussner *et al.*, 2017). Early detection in combination with a rapid response is a proactive approach, focussed on the successful management of alien species prior to their establishment. After the early detection of a species, well-coordinated rapid management measurements are required, which must take into account the specific biology and habitat characteristics to achieve the total eradication of the target species (Hussner *et al.*, 2017).

Citizen-science in combination with a national coordinating body may well be a suitable approach. Citizen-scientists have surveyed for and monitored a broad range of taxa, and also contributed data on weather and habitats reflecting an increase in engagement with a diverse range of observational science. Citizen-science has taken many varied approaches from citizen-led (co-created) projects with local community groups to, more commonly, scientist-led mass participation initiatives that are open to all sectors of society. Citizen-science provides an indispensable means of combining environmental research with environmental education and wildlife recording (Roy *et al.*, 2012). The problem of early detection by citizen-science in the case of *Gymnocoronis spilanthoides* is that it is difficult to identify the species accurately because of the absence of striking morphological features when not in flower.

EFFECTIVENESS OF MEASURE

Delaney *et al.* (2008) successfully used the data collected by citizen-scientists to create a large-scale standardised database of the distribution and abundance of native and invasive crabs along the rocky intertidal zone in Massachusetts, USA. An assessment of the accuracy of data collected by citizen-scientists showed that, depending on experience, between 80 and 95% accuracy in identification was achieved (Delaney *et al.*, 2008). In the case of *G. spilanthoides* this percentage may be lower in the absence of flowers. However, confusion with a similar looking species *Alternanthera philoxeroides* still results in a sighting of an IAS.

EFFORT REQUIRED

Roy *et al.* (2012) state that “Environmental monitoring relies on long-term support in terms of volunteer liaison, data handling, quality assurance, publication and statistical support for measuring trends, requiring the involvement of a professional scientific organisation. The use of volunteers in Citizen-science is critical for the success and is supported at a European-level through the SEBI (Streamlining European 2010 Biodiversity Indicators) “public awareness indicator” which reported that over two-thirds of EU citizens report personally making efforts to help preserve nature. The Pan-European SEBI initiative was launched in 2005. SEBI aims to develop a European set of biodiversity indicators to assess and inform European and global biodiversity targets. SEBI links the global framework, set by the Convention on Biological Diversity (CBD), with regional and national indicator initiatives. Many of the headline indicators rely entirely on the availability of monitoring data and particularly datasets on biodiversity developed by volunteer naturalists (Levrel *et al.*, 2010).”

RESOURCES REQUIRED

Integration of accurate citizen-science requires a coordinating scientific or government body. Normally the work would be funded by research grant funding, or by direct funding of scientific organisations by MS Governments. Annual costs for running citizen-science projects in 2007-2008 were estimated at between €80,000 and €170,000 (Roy *et al.*, 2012).

SIDE EFFECTS (INCL. POTENTIAL)

Positive side effects include a potential greater awareness of environmental problems by the public. The active involvement of volunteers is also likely to provide feedback on potential new non-native species.

ACCEPTABILITY TO STAKEHOLDERS

Generally, this technique is accepted by stakeholders, and involvement with research and the scientific community tends to increase acceptance of public funding of such bodies.

ADDITIONAL COST INFORMATION

No information available.

LEVEL OF CONFIDENCE[1]

High.

Citizen-science has been shown to provide significant leverage in observation power, accurate data (depending on experience and training in taxonomic identification) and should be encouraged as a valuable tool in the early detection of any invasive alien species in the EU.

1 See Appendix

Measures to achieve rapid eradication after an early detection of a new occurrence.

Physical removal.

MEASURE DESCRIPTION

Physical removal of small patches may be successful through careful and thorough hand-pulling in combination with excavation. Great care should be taken with such methods since they cause fragmentation of the plant and therefore increase potential spread (EPPO, 2016).

EFFECTIVENESS OF MEASURE

Any such measure requires follow-up monitoring and possible control measures. In New Zealand *G. spilanthoides* is listed as an unwanted organism under the Biosecurity Act 1993 and the rapid response actions required under this act have resulted in the species being eradicated from most know sites (Champion and Clayton, 2003).

EFFORT REQUIRED

As a rule, if no further plants are detected after a 5 year period an infestation is considered as eradicated (van Valkenburg, pers. comm.). Viable seed is produced in Italy (Ardenghi *et al.*, 2016) which further stresses the need for follow-up monitoring. Experimental findings in Australia hint to the seeds being potentially very persistent. However, reports on seed production for Australia appear to be contradictory and vegetative parts are the principal mode of dispersal (Panetta, 2009; van Oosterhout, 2010).

RESOURCES REQUIRED

No published information could be found for *G. spilanthoides*. Information on management cost of an early infestation of *Ludwigia peploides*, a species with a similar behaviour, in a nature restoration project in the Netherlands is available. Management of this infestation, that was detected probably 3-4 years after establishment, has cost almost € 70,000 and over 2,700 hours (staff and volunteers) in the initial 4 years of action before serious reduction of the infestations was achieved (van Valkenburg, 2016).

SIDE EFFECTS

Environmental impact is limited when the infestation is small. Hand-pulling control is mostly selective and therefore non-target plants will be not damaged. Mechanical control including excavation will affect non-target organisms. Extensive excavation works will affect natural succession processes in nature restoration projects.

ACCEPTABILITY TO STAKEHOLDERS

Mechanical control of aquatic and riparian weeds is generally accepted by stakeholders, unless considerable damage is seen to be done without any effort to reinstate the area.

ADDITIONAL COST INFORMATION

Once removed, it is very likely that regrowth from fragments will occur, despite careful biosecurity arrangements. Therefore, additional monitoring of the managed site will be required on a regular basis after removal.

Early detection and rapid eradication: given the costs of management, a prompt response to newly establishing populations will be important to avoid later management costs.

LEVEL OF CONFIDENCE[1]

High.

The published information on the reduction of infested sites in New Zealand for the species, and the more detailed info on a species that behaves similarly provide a high level of confidence.

1 See Appendix

Measures for the species' management.

Physical removal.

Gymnocoronis spilanthoides has a wide climate tolerance. © Tim Adriaens, INBO.

MEASURE DESCRIPTION

Some general recommendations on **physical removal** can be found in Champion and Clayton (2002). The feasibility of physical removal is largely dependent on the extent of the infestation, and for plants that principally reproduce via clonal fragments on the frequency of their fragmentation. The eradication of invasive alien aquatic plants should take into account the biological characteristics of the species (EPPO, 2014).

EFFECTIVENESS OF MEASURE

Physical methods that include the use of heavy machinery combined with chemicals has been found to be effective in Australia. Infestations are sprayed with herbicide to reduce the risk of spreading plant parts. Then 7-10 days later all silt and plant material up to a depth of 1 m is removed by heavy machinery. Depending on local weather conditions, all plant material is dead after about a month and the silt and soil can be reused (Australian Government, 2017). As an alternative of spreading plant material to dry out as applied in Australia, plant material could be buried on site and covered by 1 m of soil as applied in management of *Ludwigia peploides* in the Netherlands (EPPO, 2014; Plant Protection Service *et al.*, 2011; van Valkenburg, 2016).

In Japan, extensive infestations on the southern shore of Lake Biwa were detected in 2007 and 2008. Repeated weed-cutting by a concerted volunteer group supported by government had halted the spread of the species and resulted in halving the size of individual infestations every year by 2010 (Kaneko, 2012).

EFFORT REQUIRED

Any such measure requires follow-up monitoring and possible additional control measures. As a rule, if no further plants are detected after a 5 year period, an infestation is considered as eradicated (van Valkenburg, pers. comm.).

RESOURCES REQUIRED

No published information could be found for *G. spilanthoides*.

SIDE EFFECTS

Environmental impact is limited when the infestation is small. Hand-pulling control is mostly selective and therefore non-target plants will be not damaged. Mechanical control including excavation will affect non-target organisms. Extensive excavation works will affect natural succession processes in nature restoration projects.

ADDITIONAL COST INFORMATION

Mechanical control of aquatic and riparian weeds is generally accepted by stakeholders, unless considerable damage is seen to be done without any effort to reinstate the area.

LEVEL OF CONFIDENCE[1]

Medium.

Published information either refers to combined management actions, is not sufficiently detailed or relates to a similar species only.

1 See Appendix

Herbicide control.

MEASURE DESCRIPTION

Herbicide control is permitted as a single or combined management option in Australia and New Zealand (EPPO ,2016). The herbicide is applied to the emergent plants. None of the active ingredients are currently approved for use in or near water in the EU, and EU/national/local legislation on the use of plant protection products and biocides needs to be respected.

EFFECTIVENESS OF MEASURE

Glyphosate does not provide lasting effect as a non-selective herbicide. It creates gaps in the vegetation ideal for germination of *G. spilanthoides* and abscission of stem fragments and leaves creates additional propagules resulting in further spread (Australian Government, 2017). The selective broad-leaf herbicide metsulfuron-methyl does provide good control and has been permitted for use in Australia and New Zealand where the majority of field sites of *G. spilanthoides* have been eradicated using this herbicide (EPPO, 2016).

EFFORT REQUIRED

Not applicable as the method is not approved

RESOURCES REQUIRED

Not applicable as the method is not approved.

SIDE EFFECTS

Not applicable as the method is not approved.

ACCEPTABILITY TO STAKEHOLDERS

Not applicable as the method is not approved.

ADDITIONAL COST INFORMATION

Not applicable as the method is not approved

LEVEL OF CONFIDENCE[1]

Low.

None of the active ingredients are currently approved for use in or near water in the EU.

Biocontrol.

MEASURE DESCRIPTION

Neither in New Zealand nor Australia any work has been initiated as the species was either considered not sufficiently problematic or other measures were adequate (Froude, 2002; Paynter *et al*. 2009).

EFFECTIVENESS OF MEASURE

No realistic answer can be given here in the absence of any information on *G. spilanthoides*..

EFFORT REQUIRED

For classic biological control in general, the initial period of host-specificity testing would take approximately 3 years, after which the agent could be released.

RESOURCES REQUIRED

Usually significant effort is required before release of a biological control agent. The cost of this effort is estimated to be in the region of €350,000 (Paynter *et al*., 2015).

ACCEPTABILITY TO STAKEHOLDERS

Socio-economic impacts are rare and often supportive if the problem and solution are explained fully. Careful management of biological programmes is usually necessary, despite the adverse impact of the target weed..

ADDITIONAL COST INFORMATION

No realistic answer can be given here in the absence of any information.

LEVEL OF CONFIDENCE[1]

Low.

Work on potential biocontrol agents for *G. spilanthoides* has not been initiated so far.

Gymnocoronis spilanthoides *is very difficult to control because it can spread by both seed and vegetative reproduction.*
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1 See Appendix

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Appendix

Level of confidence provides an overall assessment of the confidence that can be applied to the information provided for the measure.

- **High:** Information comes from published material, or current practices based on expert experience applied in one of the EU countries or third country with similar environmental, economic and social conditions.
- **Medium:** Information comes from published data or expert opinion, but it is not commonly applied, or it is applied in regions that may be too different from Europe (for example tropical regions) to guarantee that the results will be transposable.
- **Low:** data are not published in reliable information sources and methods are not commonly practiced or are based solely on opinion. This is for example the case of a novel situation where there is little evidence on which to base an assessment.

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