Invasion et gestion de *Hydrocotyle ranunculoides* L.f. et de quelques autres espèces exotiques aux Pays-Bas

Invasion and management of Floating Pennywort (*Hydrocotyle ranunculoides* L.f.) and some other alien species in the Netherlands.

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Résumé : *Hydrocotyle ranunculoides* a été découverte comme espèce proliférante aux Pays-Bas en 1994. En 1998, la plante a causé des problèmes très graves en couvrant un ruisseau canalisé sur une longueur d'environ vingt kilomètres. En 2000 une brochure a été distribuée afin d'avertir les gestionnaires et le public à propos de cette plante et un site Internet a été ouvert pour présenter des expériences et de nouvelles observations. Depuis 2001 la vente et la possession de cette espèce ont été interdites par la loi. Des comparaisons avec d'autres espèces exotiques sont également présentées.
Mots-clés : *Hydrocotyle ranunculoides*, invasion, législation, contrôle

Abstract: *In 1994 Hydrocotyle ranunculoides was first recorded in the Netherlands growing as a weed. In 1998 the plants caused a huge problem in a river, covering the water over a length of 20 kilometres. In 2000 a leaflet was distributed to warn other water managers and the public about this plant and an internet site was opened for comments and new observations. In 2001 legislation was formulated against trade and possession of the species. Remarkable parallels were observed with other alien species.*
Key-words: *Hydrocotyle ranunculoides, invasion, legislation, control*

Introduction

Hydrocotyle ranunculoides is a morphologically and ecologically atypical member of the family Apiaceae. It is an aquatic species with round undivided leaves and tiny flowers hidden between the leaves. The plant develops dense interwoven mats of rhizomes floating on the water. The plant anchors to the bank just above and below the water level.
The species has been recorded as invasive and troublesome in Australia (Ruiz-Avila and Klemm, 1994) and the United Kingdom (Newman and Dawson, 1998).
After settling at a new site, it forms small patches (1-2 m^2) in the same season. Next year the rhizomes can grow 10 m or more within two months time, thereby totally covering the waterbody.
Hydrocotyle ranunculoides was described in the Netherlands as an aquarium plant in 1976, originating from Argentina, but these specimens were only kept in garden ponds and were destroyed after two years (pers. comm.).
In 1994 plants were found again, now in some ditches near Utrecht University. Presumably they escaped from a garden pond; garden shops had started selling the plants by that time. Since then the plants have been found at an increasing number of places in almost every part of the country (Baas en Duistermaat, 1998).

Weed problems and control

The plants became a nuisance problem in 1996 when they completely covered the surface of a ditch near Utrecht over a 2 km stretch . The plants were successfully removed by mowing boat and mowing bucket. It took four repetitive mowings, until November, but during the following three years the plants were not recorded again.
In 1998 another nuisance problem showed up. For some years the plants had been found in the Essche Stroom, a canalised and eutrophic brook near 's Hertogenbosch. The plants survived severe winters when sheltered by leaves of *Glyceria maxima* that dominated the bank vegetation and were not cut in autumn for nature management reasons.

The summer of 1998 started relatively early and the plants reached maximum growth as early as July. By the end of August 20 km of the brook was almost completely covered; the width of the covered area varied between 15 and 20 m. Plants were cut by several mowing boats and the floating material was collected by a dragline. 500 tons of plant material was gathered and stored for further processing. Analyses showed that the Cd and Zn content was too high to be processed to compost (pers. comm.). The water is known to be polluted with these metals however; on these figures alone, it cannot be concluded that *Hydrocotyle ranunculoides* has a purification value for accumulating pollutants. Removal and processing cost over 200.000 euros for this 20 km of brook only.

The banks were not only mowed, but the sod was destroyed as well to prevent survival of *Hydrocotyle ranunculoides* on roots. Most of the vegetation around the water level was removed or cut as short as possible to allow frost penetration of the soil, anticipating a cold winter.

It was impossible to collect all fragments of the plants. Some of them remained in the water and drifted away downstream, infesting a canal with protected *Phragmites* vegetation along its banks. The following year an attempt was made to remove the plants from this canal, but again a lot of fragments drifted away. This time they got into the inlet works for a large polder. In 2000 most of the ditches in this polder were infested. Two employees of the waterboard worked all summer to remove the plants. They visited these ditches every two or three weeks but they did not succeed in stopping the plants from spreading.

In 1999 and 2000 tens of places were infested; many of them could be related to garden ponds in the neighbourhood with *Hydrocotyle ranunculoides* growing very fast.

Almost every location with *Hydrocotyle ranunculoides* was eutrophic, basic and alkaline. One exception was recorded in 1998, when the plants were found growing in an acidic, weakly buffered moorland pool (de Mars and Bouman, 2002). They were, however, relatively easily removed.

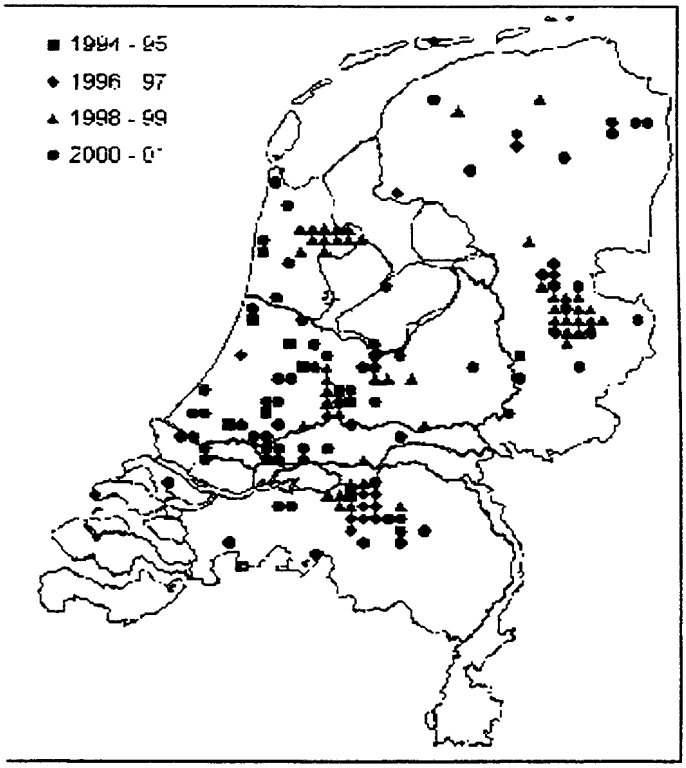

Figure 1 : Premières années d'observations aux Pays-Bas (grille de 5 x 5 km). De nombreuses observations ne concernent qu'un seul site.

Figure 1 : Year of first record in 5x5 km grid in the Netherlands; many of these refer to only one site.

Publicity

In 2000 a leaflet was produced to inform other water managers and the public about *Hydrocotyle ranunculoides* (Stowa, 2000). Also an internet site was opened for comments and new observations. Newspapers and even national television payed attention to the problem.

The number of records of the species increased remarkably in 2000. In many places the species proved to be present at least one year earlier however.

Although the effect of better recognition by distribution of the leaflet may not be disregarded, it was found that the number of sites at which the species became a nuisance increased in 2000 as well. Apart from the increased number of infestations, also the weather played part in this. Until late in autumn water temperature remained close to the summer level.

Huge extra control costs, and a clear relation between spread through garden centres and the locations of nuisance problems caused the water authorities to ask for legal action. A new law on protection of rare plants and animals that was in its final stage of preparation was found to be a suitable instrument. The weedy growth of the plants is considered to be a danger for native species and therefore an article on trade and possession of *Hydrocotyle ranunculoides* was added to this law. Legislation against a non-crop weed species had never before been formulated in the Netherlands.

Management strategies

The first approach to control *Hydrocotyle ranunculoides* was an attempt to eradicate the species. This proved to be successful on a local scale. The spread of the species all over the country through garden shops already started however. At many places the usual ditch cleaning methods, such as mowing bucket and mowing boat, even stimulated the spread and growth in facilitating the spread of plant fragments. When total biomass became high, loss of many plant fragments while mowing and collecting was inevitable.

It was also shown that plants that arrived two years or more before specific measures were taken, already had firmly settled and could not be eradicated unless repetitive and rigorous measures were taken at high costs. Some water managers are willing to make that costs anyway and success is recorded at several locations

Removal of the plants was most difficult at very eutrophic sites. The control target has largely shifted from eradication to keeping the nuisance manageable and preventing further spread.

Legislation and publicity about *Hydrocotyle ranunculoides* resulted in a halt to further spread in 2001. Although some new sites have recorded, most of them were related to earlier infestations.

It was expected that most of the plants would die in winter because of frost sensitiveness. At several places however green plants were found to survive inclusion in ice. No rhizomes in the soil above the water level were found to survive frost, so lowering the water level at periods with frost might be a good control practice. Also covering the soil with black plastic foil proved to be successful, but the side-effects (loss of all vegetation; erosion; easy re-settlement if plants survive in the vicinity) and costs make this not a recommended methods.

All plants found were unaffected by parasites or diseases. No senescent or dying leaves have been observed in any mats. It is assumed that this is unnatural and that biological agents might be found in the original habitat but have not yet been introduced to the Netherlands. Investigations to find suitable biological agents are considered.

Comparison with other alien species

Parallels were observed with other alien species. *Ludwigia grandiflora* has been recorded at three places in the Netherlands but is not spreading; *Myriophyllum aquaticum* is known at several sites for tens of years; *Pistia stratiotes* and *Eichhornia crassipes* are found regularly floating in urban waters.

These species cause the same kind of nuisance problems as *Hydrocotyle ranunculoides* in some years with long warm summers, but do not reach alarming densities or spread. They all are related to introduction through garden centres; they all grow under eutrophic conditions at which other species are controlled as well; they all are strongly reduced after severe winters (though the latter is not proven for *Hydrocotyle ranunculoides* yet). The only difference is its production capacity when management has been neglected for some time.

Water managers are now alert on the plants. When recorded, most of them immediately respond by removing the plants and repeat that every month or so afterwards. Excessive growth is prevented and

costs for removal are acceptable. Spread of the species from existing sites is strongly reduced and eradication on local scale is recorded.
Although *Hydrocotyle ranunculoides* probably will not be eradicated completely, the plant now seems under control in the Netherlands.

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