

Invasive Species Ireland

CASE STUDY 4

Water fern, *Azolla filiculoides* –Under biological control in Ireland

1. Introduction

The water fern, *Azolla filiculoides* Lamarck (Azollaceae) (Plate 1) is a small aquatic free-floating fern which has been established in Ireland for nearly a century. It originates from South, Central and North America and, as with many of these striking aquatic species, the water fern was probably introduced as an ornamental fishpond plant. Although fossil records indicate that *Azolla* species were once native to Europe it was deliberately re-introduced into Europe in 1880. The water fern has naturalized over a wide geographic range in Ireland, although recorded in relatively isolated localities, and can be periodically troublesome in ponds and slow moving freshwater habitats (Plate 1).

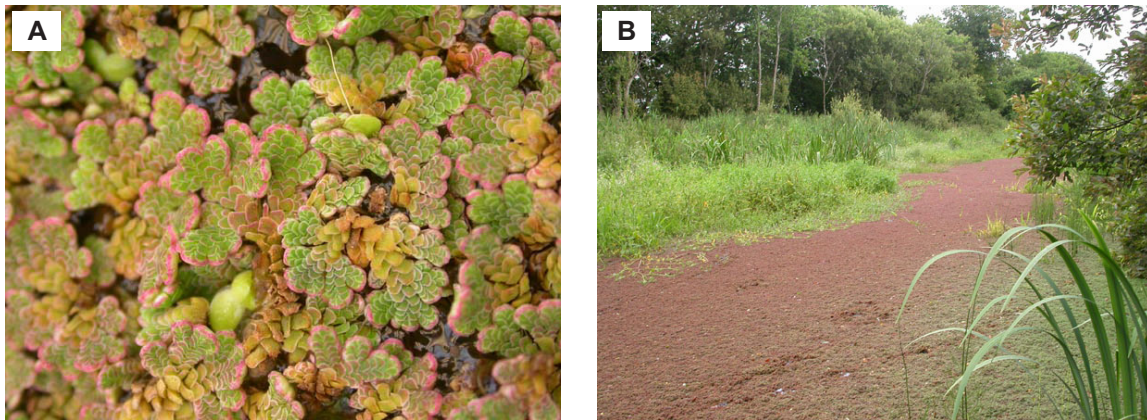


Plate 1. A mat of the water fern *Azolla filiculoides* (A). An infestation of the water fern forming a complete cover (about 3 to 4cm thick) over a slow moving canal in Co. Cork in 2008 (B).

2. Status and distribution in Ireland

The geographic distribution of the water fern in Ireland is widespread but it is naturalised in relatively isolated localities, with the exception of the River Barrow and associated canals where pockets of plants can be found throughout the system. Small isolated populations have undoubtedly been overlooked, such as those present between emergent marginal vegetation where they can be quite inconspicuous. Where infestations persist floating mats of the water fern can form a complete cover on the water surface and obstructs sunlight from entering the freshwater habitat. The water fern is capable of doubling its biomass in a very short space of time and can out compete native plants as a result. Thick mats form barriers to normal access and infestations can have negative implications for all aspects of water utilization.

3. Biological control

The water fern has been a target of a biological control programme in South Africa since 1995, where natural enemies from the fern's native range were assessed for release. One biocontrol agent, a frond feeding weevil *Stenopelmus rufinasus* was considered safe after extensive host specificity testing. Following release, the water fern was brought under complete control within a few years and no further intervention has been required. Although not deliberately released, the weevil is known to occur in the UK since 1921, where it offers periodic control of the water fern.

The weevil was first reported in Ireland in 2007 from collections made in county Fermanagh. It was subsequently recorded in county Cork in late 2007, associated with an infestation of the water fern. Since its discovery in county Cork the weevil populations have been monitored monthly to understand the insect-plant interactions under Irish conditions. The delayed build up of the weevil populations in the UK has required the mass rearing of beetles for deliberate release as an augmentative biocontrol agent. Field populations have been monitored at several sites in Ireland to assess the need for similar augmentative control to be considered as a management strategy to control this alien invasive plant.

4. Weevil biology

The adults and larvae of *Stenopelmus rufinasus* feed on the fronds of the water fern (Plate 2 A & B). Eggs are deposited into the leaf frond and early instar larvae burrow into the plant tissue. Larvae go through three stages and larger larva can be easily seen feeding on the fronds. Adults lay about 3-4 eggs/day and take about 16-20 days to complete the life cycle, depending on the temperature. The adults are robust weevils (~2mm) that can survive for a few months. Adults are highly mobile and the spread to other plant infestations may occur through adult flight or by adults attaching to water birds. The feeding activity of both the larvae and adults causes extensive damage to the plants (Plate 2 C & D)

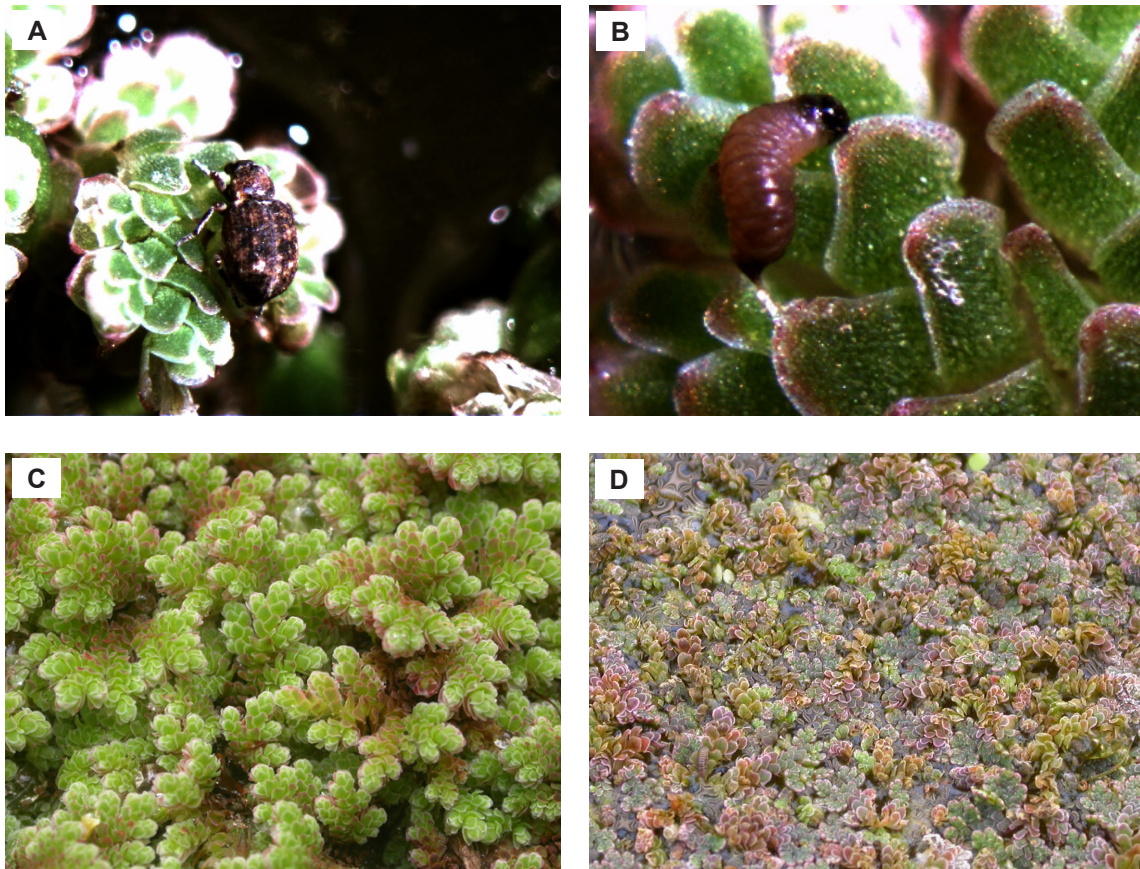


Plate 2. Adult (A) and larva (B) of the frond feeding beetle, *Stenopelmus rufinusus* on *Azolla filiculoides*. The water fern unaffected (C) and damaged (D) by the weevil adults and larvae.

5. Biocontrol of the water fern

The monitoring to date indicates that weevils over-winter as adults in Ireland and that the larvae are clearly noticeable on plants from about April. In areas suited to the proliferation of *Azolla*, it can achieve exponential growth by about March (Plate 3A) The weevil populations, however, appear only to resurge in late April-May. By July weevil populations in one dense infestation of *Azolla* in county Cork increased to such an extent that the adults and larvae occurred at circa 3000 individuals/m² and caused the collapse of the population (Plate 3B). In all the localities visited in 2008 where the water fern occurred as individual plants (i.e. low densities), the weevil has also been found to occur. The weevil appears to have the capacity to locate even small pockets of the water fern. It is noteworthy that any re-growth of the water fern at sites visited in 2008 has been heavily damaged by the weevil and was under complete control by mid-summer. In all instances weevil populations subsequently collapse as the weevils are unable to utilise the indigenous species as a food source.

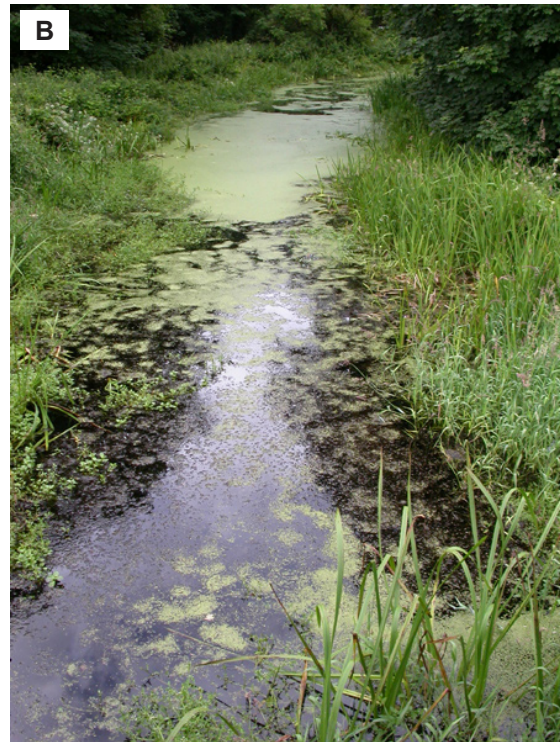


Plate 3. Monitoring site in Co. Cork in April 2008 (A) where the weevil populations were established but only attained levels of about 100 beetles/m². Same monitoring site in July 2008 (B) where the weevil had eradicated the water fern.

6. Safety of biological control

There is a general misconception that there is a significant risk to non-target species when biocontrol agents are released. As is the case with the frond-feeding weevil on the water fern, the application of weed biocontrol relies on natural enemies that are host specific and do not pose a threat to native species and do not pose a risk to commercially important species, like ornamental and forestry species. One of the most common questions posed to biocontrol practitioners is:

“What does the biocontrol agent eat once it runs out of the target species?”

Just as when the weevil controlled the water fern infestation in county Cork and thousands of beetles were on the nearby emergent vegetation (Plate 4), the weevil populations will decrease due to a lack of food.



Plate 4. After the collapse of the water fern, *Lemna* spp. replaced the infestation (A) and emergent vegetation supported thousands of adult weevils (B). These die over time as they are unable to utilise the native species as a food source.

Weed biocontrol has an extraordinarily good track record of safe application elsewhere in the world and the inadvertent arrival of this natural enemy to one of our relatively new and potentially damaging invasive species should provide reassurance that biocontrol can be safe and offer sustainable long-term control of our expanding list of alien invasive species.

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