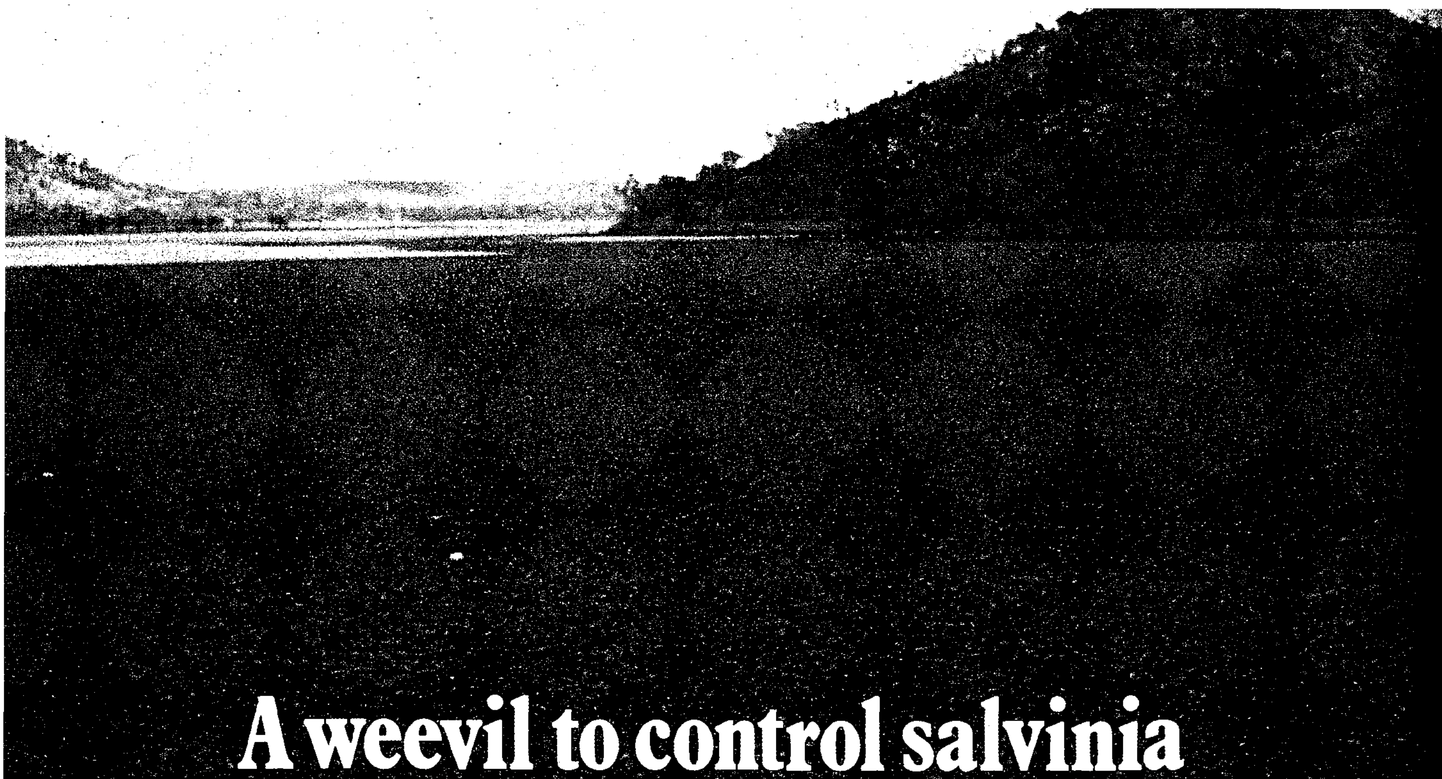
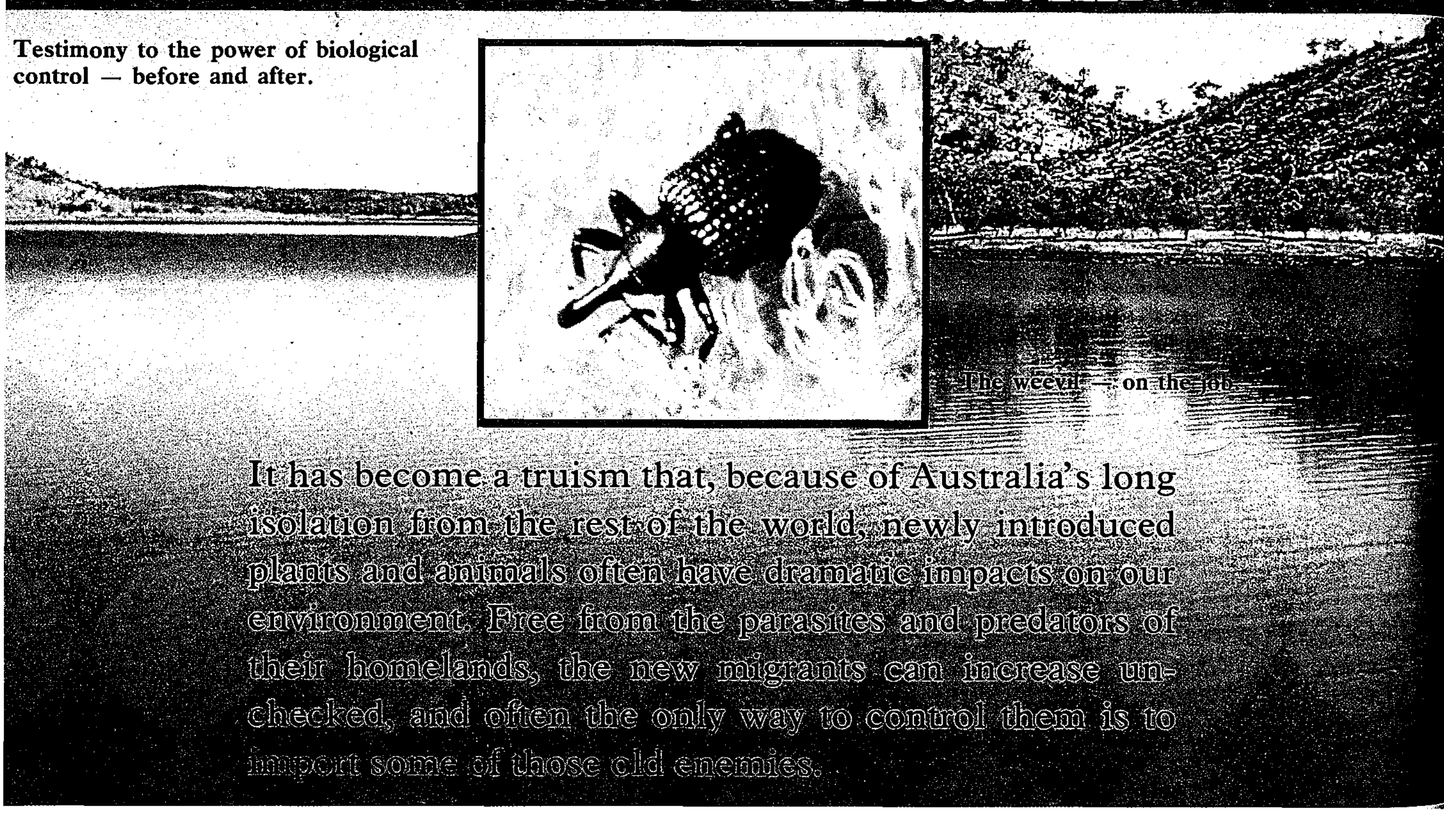


A weevil to control salvinia

Testimony to the power of biological control — before and after.



The weevil — on the job.

It has become a truism that, because of Australia's long isolation from the rest of the world, newly introduced plants and animals often have dramatic impacts on our environment. Free from the parasites and predators of their homelands, the new migrants can increase unchecked, and often the only way to control them is to import some of those old enemies.

Since our experience with prickly pear, Australian scientists have developed some powerful skills in the use of biological control agents, and the rapid clearing of the water weed *Salvinia molesta* from Lake Moondarra, near Mt Isa in Queensland, provides the most recent testimony to that power.

Salvinia was first recorded in Australia in 1952, and soon became more widespread than the water hyacinth that had been spreading through our watercourses for more than a century. It has a phenomenal growth rate, doubling its dry weight every two and a half days under good conditions. Because of this, and the absence of any insects or pathogens to hold back its growth, it can choke waterways and render once-sparkling waters — supporting a wide range of plant and animal life, as well as catering for the human thirst for water and pleasure — into stagnant untrafficable ponds supporting only salvinia.

The weed is found from Cooktown to Melbourne, and has recently penetrated into Western Australia and the Northern Territory. By 1978 the largest known infestation was on Lake Moondarra — an artificial lake used for recreation and as a source of water for the Mt Isa township. The infestation cluttered up 400 hectares of the lake and attempts to control it through the use of herbicides were abandoned in 1979, after a fruitless outlay of $160 000.

Back to the homeland

Only in 1978 was the native range of *Salvinia molesta* identified by CSIRO scientists as being in south-eastern Brazil. A search of this area by Dr Ken Harley and Ms Wendy Forno, of the CSIRO Division of Entomology's Biological Control Unit, produced three insects found attacking this species — a weevil, a moth, and a grasshopper. These were in no way new discoveries, as all had been found attacking the related *S. auriculata* in northern South America. Yet early attempts to use them against *S. molesta* had failed. However, since they were found on the target species and were possibly better adapted to it as a food source, the new collections had a good chance of proving more effective.

The weevil *Cyrtobagous singularis* was the first of the insects to complete all the formalities for release in Australia. And these formalities are quite involved.

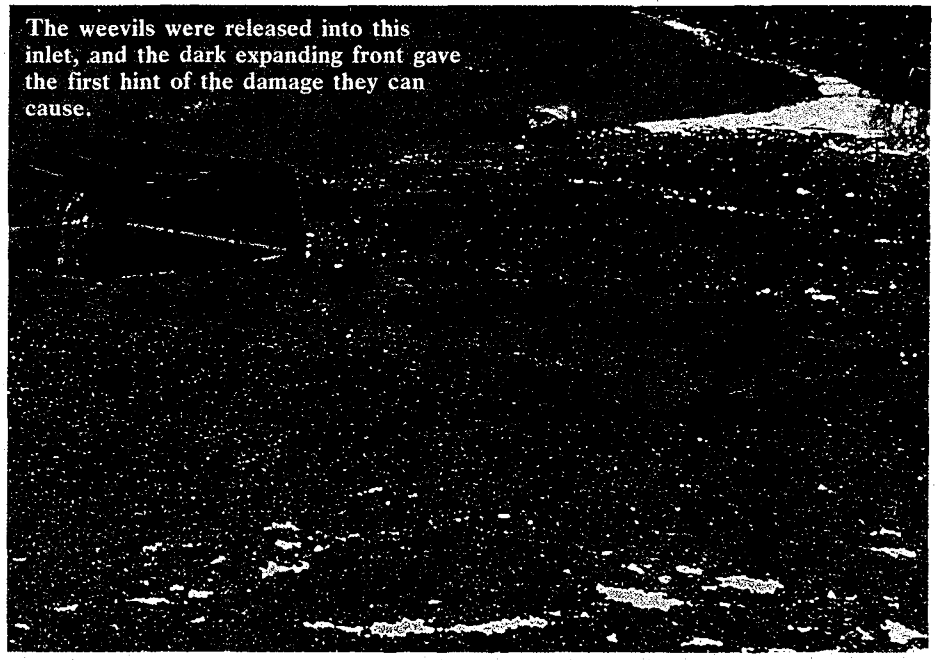
Before anything else could be done, Mr Don Sands and Mr Richard Kassulke had to establish populations of the weevil in the quarantine laboratory in Brisbane. With most insects this is not a particularly difficult task, but with *C. singularis* all previous attempts had been unsuccessful; the earlier deliberate releases of the weevil into patches of salvinia in African countries were essentially simple transfers from infested into uninfested areas. This approach is not acceptable to quarantine authorities in Australia, who demand detailed laboratory testing and studies of the insect's biology before any release can be contemplated.

The scientists soon found that what was preventing establishment of laboratory populations was a rather unusual situation: the adult weevil, when confined, competes directly with its progeny for the food supply. Other animals practise self-denial in the interests of seeing their offspring survive, but in the laboratory, the adult weevil knows no such restraint and happily munches away on whatever food is available, to the detriment of its young. To prevent this, the scientists simply removed the adults from the salvinia after they had laid their eggs, and left the larvae to develop on their own — without any adults to trouble them.

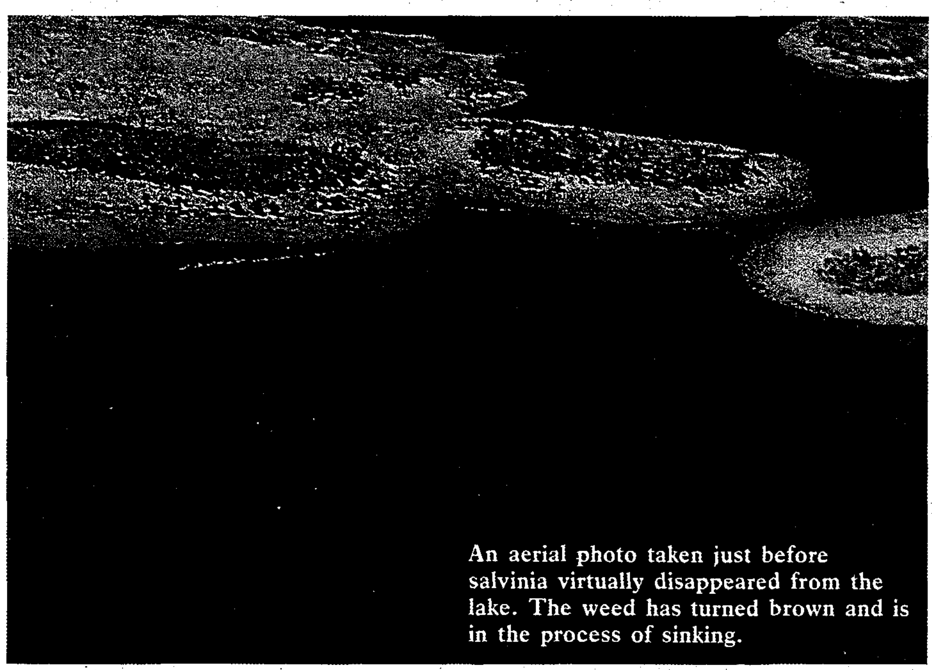
Having established good laboratory populations, they were ready for more detailed testing of the weevil. First of all, they needed evidence that it was not carrying any fellow-travellers like parasites or disease organisms that could possibly interfere with its progress in Australia, or endanger any other plants or animals.

Restricted tastes

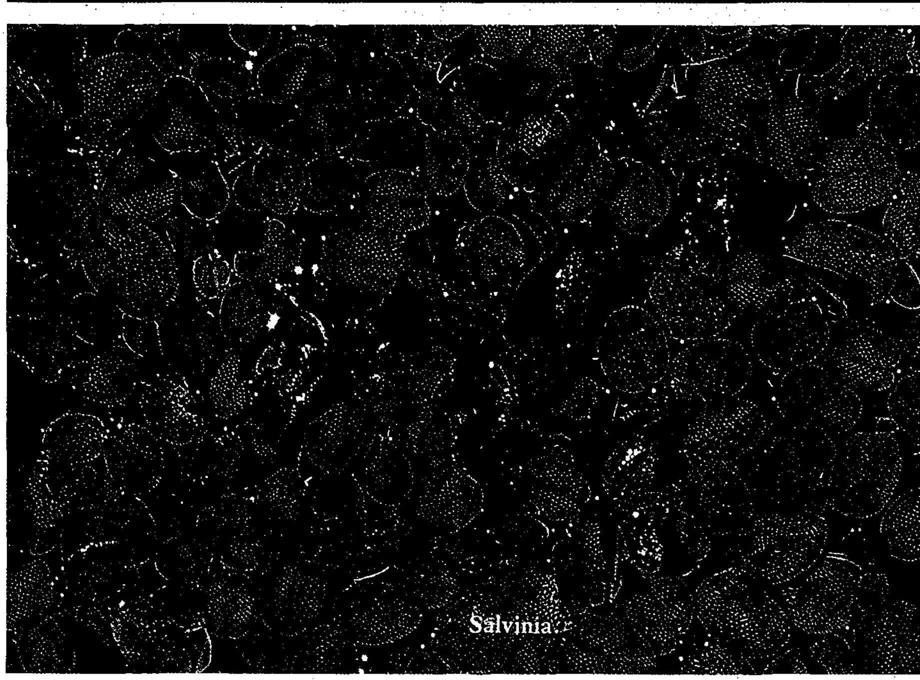
The next stage was host testing, whereby the scientists ensured that the weevil's taste was directed towards salvinia and only salvinia. They performed two sorts of host tests — a choice test in which they offered the weevils a mixture of plants, including salvinia, and a simple starvation



The weevils were released into this inlet, and the dark expanding front gave the first hint of the damage they can cause.

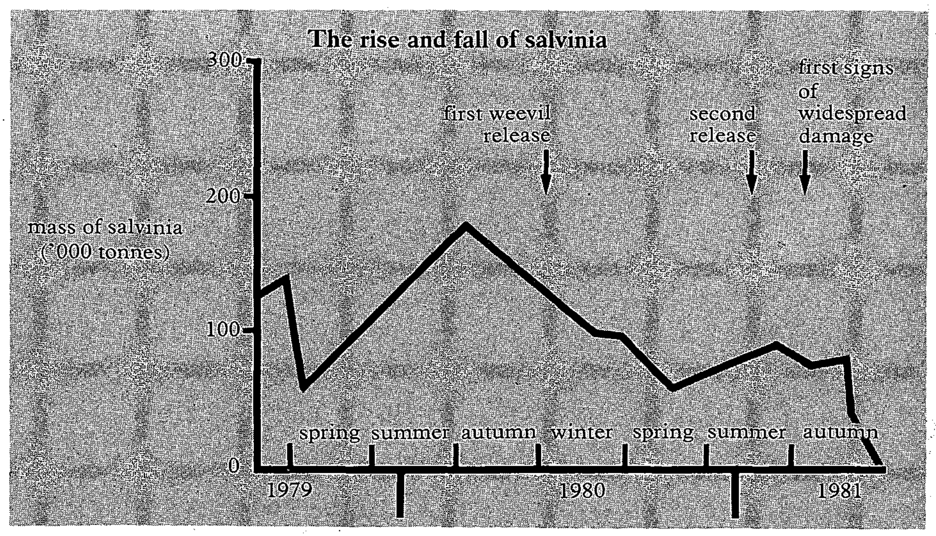


An aerial photo taken just before salvinia virtually disappeared from the lake. The weed has turned brown and is in the process of sinking.



Salvinia.

It doubles its dry weight every two and a half days under good conditions.



The weevil quickly chewed through thousands of tonnes of weed.

test in which they held the weevils on test plants until the insects either ate or died.

Three broad groups of plants are involved in any host testing of a potential biological control agent. The first group consists of economically important plants such as wheat and beans. The second contains either relatives of the target weed or plants that have some similarities to that weed — for example, plants with leaves of a similar texture or ones that grow in similar ecological niches. The third group consists of Australian native plants, and the choices made from this group are again dictated by the degree of similarity to the target weed.

Generally at least 30–60 plants are tested; the range of plants varies, depending on the nature of the target weed and its proposed biological control agent. For example, those from the first group — economic plants — will always include several varieties of rice when the target is a water weed. If the insect feeds on a woody weed, then the test plants will include more fruit trees from the first group and a greater array of native shrubs and trees from the third group.

At all stages during this testing, detailed observations on the biology of the insect are made, in order to give the scientists some indication of how the insect will perform in the field. It is also very important that the scientists have information on such things as hatching time and features of the larval stage, so that they know not only what to look for, but also when to look for it, during their studies following the field release.

Into Australian waters

In June 1980, Dr Peter Room, from the Division's Brisbane laboratories, released about 1500 adult specimens of the weevil onto a salvinia-covered inlet of Lake Moondarra. In January of the following year a further 1500 were added and large quantities of weevil-infested salvinia were moved to the opposite side of the lake. In February 1981, a violent storm swept the area and distributed the infested weed throughout the lake. From then on the salvinia population literally collapsed.

By late March, salvinia all over the lake had started to turn brown and become waterlogged; by mid April all the salvinia was dark brown. Sampling of the weevil population at this time suggested that, from the original releases of 3000 adults, the population had boomed to the extent that more than 100 million weevils were feeding and breeding on the salvinia. At the end of May very little salvinia remained, and the scientists expect the situation to stay that way, with the populations eventually settling into a dynamic equilibrium involving low numbers of both weed and weevil.

The moth *Samea multiplicalis* has only recently passed through all testing stages, and in 1981 was released into a salvinia infestation on Lake Julius, also near Mt Isa. The grasshopper *Paulinia acuminata* is still being put through the host-specificity tests.

The salvinia population literally collapsed.

The success of the weevil on Lake Moondarra may be attributed to the fact that it was collected on the weed concerned. Apparently the *C. singularis* biotypes found on other species of *Salvinia* in northern South America were not so strongly adapted to *S. molesta*, and this helps explain their previous poor performance.

Another contributing factor may be that, as the successful *C. singularis* biotype was collected in a cooler southern climate, the weevil's eggs could have a lower temperature requirement for hatching. Perhaps, when transferred to a warmer climate, these eggs respond by developing and hatching much earlier, providing a shorter generation time and a more rapid population build-up, with all its deadly consequences for salvinia.

Mr Sands and Dr Room are still exploring some of these aspects of the weevil's biology on Lake Julius, where the insect was released in April 1981. They have a particular interest in resolving whether the weevil population they are using is a cool-climate biotype that performs well in a tropical environment, because in biological control work scientists have always attempted to match the environments where the weed is found in Australia with the environment where they collect any potential control agent.

Already the scientists have indications that their weevil may not perform so well in the cooler environs of Brisbane, and they don't want to make large widespread releases into other salvinia infestations within Australia until they have firm data that will allow them to predict how the weevil, moth, and grasshopper will perform in different environments.

However, they are making one exception. Villagers on the Sepik River in Papua New Guinea, being nearly totally dependent on the river for food and transport, are facing starvation because salvinia has virtually choked out all fish life and made many waterways impassable. The weevil will soon be released there, and its progress monitored. The information the scientists gain about the weevil's performance will not only have application in controlling salvinia in other parts of the world, but may also influence the approaches adopted to selecting future biological control agents.

Wayne Ralph

More about the topic

Successful biological control of the floating weed salvinia. P. M. Room, K. L. S. Harley, I. W. Forno, and D. P. A. Sands. *Nature*, 1981, **294**, 78–80.