## Water hyacinth and alligator weed

When the Division of Entomology began research into biological control of water weeds, it tackled each of Australia's main water-weed species — water hyacinth, salvinia and alligator weed — at the same time, knowing that if only one species were controlled, more space would be available for eventual invasion by another.

This has already occurred in Papua New Guinea: the Sepik River area so successfully cleared of salvinia during the early 1980s has now come under very serious threat from water hyacinth. Initially found only around Madang, on the country's northern coast, water hyacinth has recently spread to lakes in the lower Sepik floodplain and is rapidly invading the main river and billabongs and tributaries along the lower half of its 1300-km course. It is also spreading near Port Moresby, threatening the main water supply to the capital city.

Several insects have been released, with considerable success, in Australia to control water hyacinth, the most recent being a robust weevil, *Neochetina bruchi*, from South America. In collaboration with the country's Department of Agriculture and Livestock, the Division is seeking resources to begin a water-hyacinth control program in Papua New Guinea.

In Australia, researchers have developed a double-pronged approach to the control of alligator weed (*Alternanthera philoxeroides*), which has emerged as an even more potent threat in temperate regions than salvinia.

Originally introduced into Australia from South America, alligator weed was first noticed near Newcastle in 1944. It was recognised as a potential major aquatic weed in the 1970s, by which time it had spread sufficiently to threaten sensitive wetlands as well as irrigated agricultural land in the Murray–Darling Basin, on the George's River and its tributaries in Sydney's southern suburbs and in the Stockton–Williamtown area near Newcastle. Its rate of spread has been estimated at 10% per year. Like salvinia, alligator weed does not rely on seeds to reproduce itself. It spreads when tiny fragments are broken off the 'parent' plant: for example, when trodden by cattle or by farm machinery, through being broken up by feeding carp or even as a result of a sudden drop in temperature. Unlike salvinia, however, it 'attacks' on two fronts, flourishing in both aquatic and terrestrial forms; in terrestrial situations the weed now covers an estimated 2000 ha.

Mr Mic Julien of the Division of Entomology has succeeded in bringing aquatic alligator weed under control with a double-barrelled approach. Beginning in 1977, he has been releasing flea beetles (*Agasciles hydrophila*) and moths (*Vogtia malloi*), both of which were originally collected from alligator weed's native range in southern Brazil and Argentina, on mats of weed.

The moths do not feed on alligator weeds as adults, but lay eggs on the leaves. The newly hatched larva bores into the hollow stem and travels down to a point just above a growth node, where it effectively ringbarks the stem from the inside. All of the plant above that point is killed; but while this strategy still allows the plant to continue growing, the complementary activities of flea beetles deal it a second and fatal blow.

Adult *Agasciles* flea beetles feed externally on the weed's leaves and stems. Their larvae also feed externally on leaves and stems, then tunnel into the hollow stems — sealing their entry hole behind them — to pupate. The newly emerged adults cut exit holes that allow water to enter and secondary rotting to occur: the combination of holes and invasion by destructive organisms assists in the eventual break-up and sinking of the waterlogged plant.

Biological control of aquatic alligator weed has been consistently successful and large floating mats of it have disappeared, leaving the species as a fringing weed along waterways, where stable populations of flea beetles and moths are preventing re-colonisation.

Until recently, however, terrestrial infestations remained impressively resistant to chemical control. Dr Kathleen Bowmer, of the Division of Water Resources, working with researchers from the National Herbarium of New South Wales and the University of New England, found that although above-ground parts of the plant can be scorched with broad-spectrum 'knock-down' herbicides such as glyphosate (marketed as Roundup®), very little of the chemical is translocated underground... and of that, about 25% is excreted by roots and rhizomes. Indeed, Dr Bowmer found that alligator weed is resistant to 101 herbicides.

However, she has discovered that a double-barrelled 'blast' of the herbicides dichlobenil and metsulfuron, followed by a second spray of mestulfuron or glyphosate, effectively controls terrestrial alligator weed — precisely in those situations where it is most resistant to other forms of control. The use of appropriate herbicides avoids the risk of damage to non-target species and provides an opportunity for desirable plants to recolonise areas formerly choked by alligator weed.