WATER WEEDS INTO THE THIRD CENTURY

S.W.L. Jacobs[1] and G.R. Sainty[2]
[1]Royal Botanic Gardens, Sydney, N.S.W. 2000
[2]Sainty and Associates, PO Box 1219 Potts Point, N.S.W. 2011

Summary. Our aim is to try and make some predictions on the likely distribution and range of species of water weeds in Australia into the third century, by examining the establishment and introduction of exotic aquatic species in the first two centuries.

THE FIRST HUNDRED YEARS

The first hundred years is fairly easy to deal with. The Flora Australiensis (6) covers the first 75 years and we will use this for convenience. The first list complied by Robert Brown (7) includes no introduced aquatic species. Bentham (6) records only *Cyperus eragrostis*, *Echinochloa crus-galli*, and *Polypogon monspeliensis* of the aquatic species we now consider to be introduced. These three are still around, though only *E. crus-galli* is of major significance.

THE SECOND HUNDRED YEARS

During this period a conservative list includes a further 48 species (total of 51 spp.) and any such list will underestimate the actual situation. This list includes all of the species usually regarded as the most significant water weeds (these have been classified into a two category or tier system, Tier 1 and Tier 2) (1). The classification of a species as a major weed is rather arbitrary. Of the four Tier 1 species, two, water hyacinth, *Eichhornia crassipes*, and salvinia, *Salvinia molesta*, have been here for some time and have had considerable sums spent on their control.

Water hyacinth seems to have decreased far more dramatically than could be expected from control measures alone. Several anecdotal stories from the turn of the century paint horrific stories of the build up of water hyacinth (2). In the Australian tropics, biological control has been moderately successful. In the south, biological control has not been as successful but the species has not spread as dramatically as was predicted, and actually seems to have declined somewhat. This is probably due to a variety of reasons including manipulation of the waterflow (e.g. the Ginham Creek watercourses of N.S.W.), the reduction in nutrient enrichment of some streams and wetlands, effective chemical control, and for other reasons that we cannot explain. Could the decline of water hyacinth in northern N.S.W. coastal rivers be more an accidental side-effect of flood mitigation schemes than the result of a purposeful campaign?

The other species in Tier 1, *Alternanthera philoxeroides* and *Lagarosiphon major* have been included for different reasons.

Alternanthera philoxeroides is here and spreading despite, considering the area it covers, considerable sums spent on both chemical and biological control. This potential has been estimated from the problems the species has caused and the costs involved in its control elsewhere in the world. *Alternanthera philoxeroides* has yet to cause any major problems in Australia, although the blockage of Georges River near Liverpool demonstrated its potential. The failure of current biological and chemical control techniques to do more than slow down the spread from its as yet limitied distribution is an ominous sign.

Lagarosiphon major was smuggled or unintentionally brought to Australia and subsequently cultivated for use in indoor aquaria. In the 1970's it was sold as an alternative to the less potentially troublesome *Elodea canadensis* and *Egeria densa*. Even though *Lagarosiphon* has been around for some time it does not appear to have become naturalised. It has potential to grow free-floating submerged in deep cold-water storages. Elsewhere (e.g. New Zealand) chemical control measures have proved ineffective and costly, physical procedures have had to be used. This species has been placed in the Tier I category because of its potential to grow in economically significant habitats and the lack of suitable control methods.

Three species now listed as Tier II were initially treated with as much apprehension as *Lagarosiphon*, because of their potential to cause problems estimated from their behaviour elsewhere in the world. The three species are *Egeria densa*, *Elodea canadensis*, and *Myriophyllum aquaticum*. All three species invoked what were, at the time, quite extensive campaigns aimed at minimising spread and, hopefully, their eradication. *Elodea canadensis* is a good example, it was first recorded in 1958 in irrigation areas along the Murray River, spreading to Victoria from N.S.W. It spread rapidly vegetatively (only male flowers recorded) causing considerable problems. In the 1970's it appeared in irrigation areas along the Murrumbidgee River but has failed to spread to the extent it did in Victoria. The species has apparently reached a peak in its vigour as expressed by the density and rate of growth, much the same as has been reported for it in England and Europe (12).

The same phenomenon has occurred here with *Egeria densa* and *Myriophyllum aquaticum*. Despite initial phases of active growth and colonisation both species have lost their initial vigour. Is it a coincidence that only one sex of each species is present here? It may be, but the risk is sufficiently high to warrant the prevention of further imports to reduce the possibility of sexual reproduction. Does the loss of vigour correspond with a decrease in enthusiasm for the control measures? Is it possible that control measures provide ideal situations and habitats for the continued growth of the species? Do we slowly and subtly change management options and procedures so as to minimise the growth and spread of the species? Or is it a mixture of all of the above? What is the probability that *Alternanthera philoxeroides* and *Lagarosiphon major* would similarly peak and lose vigour? It is difficult to tell from the literature because statements like "Dangerous new exotic weed infests 2,000 ha" grab attention, are comparatively easy to quantify and are "newsworthy" whereas statements such as "Exotic weed slowly loses vigour over 10 years" are difficult to quantify and much less "newsworthy". Even if the probability of *Alternanthera philoxeroides* and *Lagarosiphon major* losing vigour is high, can we afford to take the chance? We think the answer has to be no. If a weed species can be contained to only a fraction of its potential range. Then the savings appear to be quite large even if only one in ten would have become long-term troublesome weeds.

A lot of work has quantified the introduction and spread of weeds (3, 4, 5, 8, 9). This has been concerned with the spread of "new" weeds in the sense of recent arrivals. The rate of spread of newly arrived weeds is dependent on a mixture of biological features, potential climatic range and the number of centres from which the species is spreading (5). Not all "new" weeds are new for this reason. Some are reclassified as "new" after management changes allow species that were previously well-dispersed and common, but not growing in high densities, to increase their densities substantially till they justify the allocation of resources in an attempt to limit their growth. Two such exotic species, *Alisma lanceolata* and *Sagittaria graminea*, are weeds of rice

in irrigation areas along the Murrumbidgee River (10) that have been in the area for decades (2) but have only assumed major weed status since the change in rice cropping procedures. Two native species, *Diplachne fusca* and *Typha domingensis*, both present in the area for millenia, have likewise only become weed problems since the change in management practices to annual cropping without quotas and the abandoning of crop rotation. Altered management practices and new technology are becoming increasingly important "origins" of weeds as species become reclassified due to their pre-adaptation to the new conditions.

Thus, this second hundred years has seen dramatic changes from the first hundred years in terms of water weeds. From a century almost free of serious water weeds we have seen the rise and partial fall of species like *Eichhornia crassipes*, *Elodea canadensis*, *Egeria densa* and *Myriophyllum aquaticum*. We have seen the rise and spread of *Salvinia molesta* and *Brachiaria mutica*. We have seen the establishment of *Alternanthera philoxeroides* and *Ludwigia peruviana*, and the irresponsible release of *Lagarosiphon major*, *Cabomba caroliniana*, *Gymnocoronis spilanthoides*, *Hymenachne amplexicaulis*, and *Echinochloa polystachya* (11).

WEEDS INTO THE THIRD CENTURY

If conditions and management practices stay much as they are then the prediction for at least the earlier part of the third hundred years would be for species like *Eichhornia crassipes*, *Egeria densa* and *Elodea canadensis* to decline slightly till they become of only local significance. *Salvinia molesta* could be expected to continue as a major problem for some time, despite localised success with the biocontrol agent *Cyrtobagus salviniae*. It is probably too late to stop the slow spread of *Alternanthera philoxeroides* and it seems likely to assume increasingly more importance. Weeds in rice (10) seem likely to increase in significance as do the two newly introduced grasses (*Hymenachne amplexicaulis* and *Echinochloa polystachya*) in wetlands and irrigation systems in the tropics. We will be optimistic and assume that at least the present occurences of *Lagarosiphon major*, *Cabomba caroliniana* and *Gymnocoronis spilanthoides*, despite the partial resistance to herbicides (glyphosate and amitrole) by the latter, seem to have been contained, but all have the potential to develop as major weeds and all are already here. There are also the water weeds and non-weedy native aquatic species from other countries not yet introduced into Australia.

Of all these predictions we feel confident of only one, viz. that things will <u>not</u> stay the same. For example, predicting the future of the rice-growing industry and its management systems, its new technology, and hence the weeds in rice is a difficult exercise. Likewise the problems in other irrigated crops, salinisation of some irrigation areas, and new technologies are impossible to predict in all but the shortest of terms. Coupled with our ignorance of the basic biology of the majority of all the potential weeds the task of predicting the weeds of the third century is like predicting Melbourne Cup winners for the third century, difficult enough in the short-term, impossible in the longer term. Existing native and exotic species have the potential to spread due to changes in the status of the wetland such as a change in cropping practice, altered nutrient status, or changes in water flow including water levels and velocity.

Although we cannot predict the significant water plants of the future it is possible to predict some of their characteristics from our past experiences (much the same with horse races). We would expect the major aquatic weeds of the future to have one or more of the following characters:

(i) free floating, either surface or submerged
(ii) reproducing vegetatively from small stem pieces
(iii) having a record of weediness in other countries.

Using this list (or, preferably, an expanded version) as a guideline we may be able to reduce the numbers of potential weedy species that are imported into Australia. We may also identify those that do make it as soon as possible after they become established and initiate programmes for containment of possible eradication.

REFERENCES

1. Australian Water Resources Council. 1982. Water Management Series No. 3 56 pp.
2. Aston, H.J. 1973. Aquatic Plants of Australia. (Melb. Univ. Press: Melbourne) 368 pp.
3. Auld, B.A. and Coote, B.G. 1980. Oikos 34, 287.
4. Auld, B.A., Coote, B.G. and Menz, K.M. 1979. Proc. 7th Asian-Pac. Weed Soc. Conf. p. 399.
5. Auld, B.A., Menz, K.M. and Monaghan, N.M 1979. Proct. Ecol. 1, 141.
6. Bentham, G. 1863, Flora Australiensis, L. Reeve, London, Vol. 7.
7. Britten, J. 1906. J. Bot. 44, 234.
8. Harper, J.L. 1977. Population biology of plants. (Academic Press: London) 892 pp.
9. Menz, K.M. and Auld, B.A. 1977. Search 8, 281.
10. McIntyre, S. and Newnham, M.R. 1987. Cunninghamia Vol. 2. (In press).
11. Sainty, G.R. 1987. Proc. Int. Symp. Wetlands. (ed. K. McDonald) (In press).
12. Sculthorpe, C.D. 1967. The Biology of Aquatic Vascular Plants. (Edward Arnold: London) 610 pp.