THE WEEVIL, *NEOCHETINA BRUCHI*, COULD HELP CONTROL WATER HYACINTH IN AUSTRALIA

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Summary. N. bruchi is a weevil used successfully overseas as a biological control agent of water hyacinth. It is being considered for liberation in Australia to supplement the effects of control agents already present. Using the computer program CLIMEX, overseas locations of water hyacinth infestations controlled by *N. bruchi* were climatically matched to Australian locations. The results suggest *N. bruchi* could be a valuable biological control agent of water hyacinth not only in Australia's tropics, but also in cooler regions where existing biological control agents appear less effective.

INTRODUCTION

Water hyacinth, *Eichhornia crassipes* (Mart.) Solms, is a floating aquatic plant commonly regarded as the world's most serious aquatic weed. It is native to South America and was introduced to Australia about 1894. Chemical and mechanical control methods have been used against it since the early 1900s. Biological methods of control commenced in the 1970s.

<u>Biological control of water hyacinth</u>. Biological control causes a gradual deterioration in plant vigor, with decreased flower and therefore seed production. Ultimately, plant death occurs. In addition to climate, insect nutrition/plant quality influences the speed of biological control. Control rarely occurs quickly, usually taking five years or more after the arrival of insects at each site.

Several insects, a mite, a fish and at least one plant pathogen have been suggested as biocontrol agents. In Australia, two of the insects are now widely distributed; a weevil, *Neochetina eichhorniae* , and a moth, *Sameodes albiguttalis*. Another weevil, *Neochetina bruchi,* is also used overseas. In many of the countries where insects were liberated, insufficient time has elapsed for a review of their effects on the weed population.

Although the moth *S. albiguttalis* is effective against infestations of the weed at some locations, most attention worldwide has focused on the two weevils as they offer good prospects for widespread control of the weed. In 1974 CSIRO obtained permits to import both weevils into Australia and colonies were established in CSIRO's Brisbane quarantine from cultures sent from the United States. However studies on *N. bruchi* were abandoned pending more information on the performance of *N. eichhorniae* in Australia and on the interaction of both in the USA. The colony of *N. bruchi* was destroyed.

N. eichhorniae was first released in Australia in September 1975 (*S. albiguttalis* was released later in October 1977). Although many infestations came under control, there were many others - especially in cooler parts of the weed's distribution - where there was either little or no impact on reducing the stand of water hyacinth or where greater control was desirable. Despite this, it was decided to terminate the CSIRO research on water hyacinth in 1985 principally due to lack of resources.

<u>Effects of N. bruchi overseas</u>. Information obtained overseas between 1985 and 1989 suggested *N. bruchi* should be reconsidered for introduction to Australia. Near Houston, Texas, *N. bruchi* by itself achieved 90% control of an infestation on a reservoir (2). Near New Orleans, Louisiana, *N. eichhorniae* and *N. bruchi* together reduced the total water hyacinth area by an estimated 320,000 ha (3,5,6). In central Florida, *N. bruchi* and *N. eichhorniae* together controlled water hyacinth infestations (T.D. Center, pers. comm. 1989) and in the Sudan they prevented the usual yearly build-up of over 100 km^2 of floating mat behind the Jebel Aulia Dam near Khartoum (1). At a tropical site near Bangalore, India, 90% control of a 20 ha infestation

resulted from release of *N. bruchi* alone (7). In Argentina *N. bruchi* alone controlled a water hyacinth infestation on a reservoir near La Rioja city (4).

In addition to these results came suggestions that (a) a greater impact on water hyacinth occurs when both weevil species are present than when either species is present alone, and (b) *N. bruchi's* contribution to biological control is commonly under-rated because of its greater sensitivity to declining plant quality compared to *N. eichhorniae* (T.D. Center, pers. comm., 1989), and (c) *N. bruchi* has a greater tolerance of cool climates than *N. eichhorniae* and may be more effective in areas of Australia where *N. eichhorniae* has had only a marginal impact on the weed (B.D. Perkins, pers. comm., 1988).

CSIRO therefore recommenced its water hyacinth program, and in August 1989 imported stocks of *N. bruchi* into quarantine and began host-testing. We wanted to predict the likely success of *N. bruchi* in Australia before its liberation by using a climate-matching computer program, CLIMEX, to match climates of overseas locations reporting successful biocontrol of water hyacinth with major Australian locations.

METHODS

The CLIMEX program was developed by personnel of CSIRO's Division of Entomology as a risk assessment package (9). Although it is possible to deduce the most favourable locations for an organism from its biological data, in this case the biological control agent is dependent on the presence of its host plant. Of all the capabilities of CLIMEX, the Climate Matching facility we used is perhaps the simplest. With this option an index can be generated to describe the climatic similarity between any two locations in the climate database. The index is based on maximum and minimum temperatures, rainfall and rainfall distribution. We matched locations of successful biocontrol of water hyacinth with *N. bruchi*, with and without the presence of *N. eichhorniae.*

The locations chosen as examples of biocontrol were Houston and New Orleans in the USA, Bangalore in India and Khartoum in the Sudan. CLIMEX had no listing for La Rioja, Argentina, or a nearby location which could be used for matching with Australian locations. We placed more importance on the US sites because we doubted the validity of matching climates tropical locations of water hyacinth because the plants do not experience the extreme temperatures indicated by meteorological data. (Water hyacinth plants cool themselves by marked evapotranspiration and the insects on and inside the plants presumably benefit.)

RESULTS AND DISCUSSION

The closest Australian climate-matches to New Orleans were Lismore, Brisbane, Port Macquarie, Coffs Harbour and Williamtown in that order. Similarly, locations matching the climate of Houston (the only US study site with just *N. bruchi* present) were Williamtown, Brisbane, Gympie, Sydney and Lismore. This shows *N. bruchi* appears to have promise in the cooler parts of water hyacinth's Australian range, where better control of water hyacinth is needed.

However the success of *N. bruchi* at water hyacinth infestations in tropical areas overseas indicates it could also be a valuable agent in tropical Australia. CLIMEX matched Bangalore to Rockhampton, Charters Towers, Mareeba, Georgetown and Burketown, while only three Austalian locations in the CLIMEX database were found to match the climate of Khartoum (Mandora, Marble Bar and Telfer in W.A.). The biggest unknown factor which could influence the performance of *N. bruchi* in Australia relates to its possible sensitivity to low plant quality as suggested by Center in Florida.

With regard to further research on biocontrol of water hyacinth, Australia and Thailand have succeeded in attracting research funds from the Australian Centre for International Agricultural Research (ACIAR), and expect to liberate *N. bruchi* this year. The countries are in a unique position. Neither now has *N. bruchi* but both have had *N. eichhorniae* established in the field for many years. Both also have scientific bodies which are enthusiastic proponents of biological control of water hyacinth and experienced in water hyacinth monitoring. Therefore Australia and Thailand may be able to determine the existence and size of any additive controlling effect due to the presence of *N. bruchi* in addition to *N. eichhorniae*. This information could be of great interest to Australia, Thailand and countries yet to liberate either or both the weevils.

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