

Water Hyacinth in China: Its Distribution, Problems and Control Status

Ding Jianqing, Wang Ren, Fu Weidong and Zhang Guoliang*

Abstract

Water hyacinth is one of the most important invasive alien plant species in China, into which it was introduced in the early 1900s. Now the weed is distributed in 17 provinces, and in Guangdong, Yunnan, Fujian, Zhejiang and Taiwan has become a bio-disaster. Compared with the situation in 1960, few people now use water hyacinth plants to feed pigs or ducks, or to make fertilisers. It poses a great threat to agriculture, fisheries, transportation and the environment. It is estimated that each year more than 100 million RMB yuan (US\$12m) is spent on control of water hyacinth throughout China, but in most areas the weed remains vigorous and continues to spread. Chemical, mechanical and biological control, as well as integrated control strategies, have been employed to combat water hyacinth in more than 10 provinces. Two weevils, *Neochetina eichhorniae* and *N. bruchi*, which were introduced from Argentina and USA in 1995, have established and spread their populations in Zhejiang and Fujian provinces. The weevils greatly suppressed the plants around the release areas. In early 2000, a mirid, *Eccritotarsus catarinensis*, was introduced from South Africa but did not establish. A survey for pathogens of water hyacinth began in spring 2000 in southern China.

WATER hyacinth was introduced into China in the early 1900s. As an ornamental plant, it was first introduced into Taiwan in 1903 from Southeast Asia. In the 1930s it was introduced to the mainland (Diao 1989). But the first scientific record appeared for the mainland in 1954 in the book, 'Taxonomy Catalogue for China's Plants: Families and Genera' (Anon. 1954). In the 1950s and 1960s, water hyacinth was distributed widely into almost all provinces for animal food. After artificial transplanting and mass rearing and breeding, water hyacinth was distributed to further areas in the 1970s and began to cause damage in the 1980s. Increasing damage has been reported since the 1990s as nutrient levels increased in water bodies and the use of water hyacinth plants began to fall.

* Biological Control Institute, Chinese Academy of Agricultural Sciences, 12 Zhongguancun Nandajie, Beijing, 100081, China. Email: djq@public.east.cn.net

Distribution

Water hyacinth is now distributed naturally in 17 provinces or cities in China. In several other provinces water hyacinth is still utilised but cannot overwinter. Water hyacinth causes damage in more than 10 provinces (Ding et al. 1995). Great damage has been reported in five provinces: Yunnan, Guangdong, Zhejiang, Fujian, Taiwan. Figure 1 maps the distribution of water hyacinth in China.

Problems Arising from Water Hyacinth

As in many other countries, in China water hyacinth has caused many economic, social and environmental problems. It blocks waterways, affects water transport for agriculture and tourism, covers lakes and rivers, lowers the dissolved oxygen in water bodies and

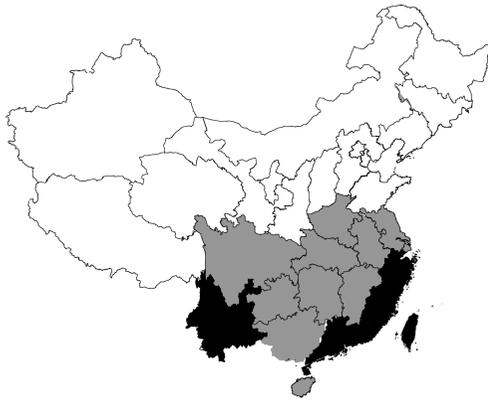


Figure 1. The distribution (shaded areas) of water hyacinth in China. Black areas are where damage is greatest.

reduces aquatic production. It also affects the irrigation of agricultural fields.

As an invasive alien species, water hyacinth has posed a great threat to biodiversity by competing with native plants for water, nutrients and space. At Caohai, Dianchi Lake, in Yunnan province, southwestern China, the plant diversity has been greatly reduced in the past 30 years because of the competition by water hyacinth and the increased water pollution. The number of water plant species at Caohai has fallen from 16 in 1960, 8 in 1970, 5 in 1980, to 3 in 1990 (Wu 1993). The plants absorption of heavy metals causes a second water pollution problem after they die and sink. In rural areas, after control by harvesting, huge numbers of plants were always heaped together along the banks of rivers and allowed to decay, which greatly affected environmental quality (Wu 1993).

Water hyacinth has also caused a series of problems to local society in China. People have difficulty in their daily lives as it covers their rivers, ponds and lakes. The health of local people is threatened as water hyacinth provides a habitat for mosquitoes and flies. It is said that water hyacinth even creates a public security issue: dense and high water hyacinth plants provide a nice place for criminals to hide.

Utilisation of Water Hyacinth

During the 1950s–1970s, water hyacinth was widely used for animal food in China, as at that time, the economy in rural areas was very depressed and there was great shortage of food for animals. It was also

used for fertiliser in a few areas. Some people even tried to make paper from water hyacinth plants. But since the end of 1980s, and the economy improved, the number of people seeking to use water hyacinth has fallen. The sole use of water hyacinth now, and in only a few places, is for feeding ducks. In some environmental institutes, water hyacinth is used as a test plant in the purification of polluted water.

Control Status

Manual removal has been employed in most areas in China in the past 10 years. It is estimated that more than 100 million RMB yuan (US\$12m) was spent on artificial control of water hyacinth each year but the practice was neither economic nor effective. Mechanical control is used in only a few places, but it cannot provide long term control. In some areas, herbicides such as Roundup and paraquat were used, but they are prohibited in some places where the water is used by people and animals.

Biological Control

In China, biological control activities for water hyacinth were initiated in early 1995, when the Biological Control Institute (BCI) introduced two weevils *Neochetina eichhorniae* and *N. bruchi* from the USA and Argentina, respectively. Upon the request of the local government, host range tests for the two weevils were conducted in Kunming, Yunnan Province in 1995. Forty-six plant species from 23 families representing local economic, ornamental, and ecologically important plants (Ding et al. 1998) were tested. As they had done previously in the USA, Australia, India and other countries, host range tests showed the weevils attacked and completed their life cycles only on water hyacinth and they were safe to other local plant species.

After host-specificity tests, weevils were first released at four rivers in Wenzhou and Zhejiang provinces in September 1996. Some 1000 individuals of a mixture of the two weevil species were released at each river. The weevils established at all the four rivers within one year of release. At Lincun River, about 50% of water hyacinth plants were killed in late spring 1998, while a native grass, *Paspalum* spp., recovered and occupied the space where water hyacinth grew. Since then, the density of water hyacinth has varied seasonally between 10 and 50% of coverage of the water surface. By means of water flow, the weevils spread rapidly to water bodies up to 40 km from the release site by the summer of 2000 (Ding et al., unpublished data).

In 1998, the weevils were distributed to Fuzhou, Fuqing and Fuan cities of Fujian Province where water hyacinth was a great disaster. They established quickly, as it was warmer than in Zhejiang Province. Significant control has been achieved at several release sites but no detailed survey results are available yet.

In the early summer of 2000, a colony of the weevils was introduced to Ningbo, another city of Zhejiang Province, where they were released in one river. There is some concern about the ability of the weevils to overwinter there. Located at around 30°N, Ningbo is in the north of Wenzhou and Fujian. In some years when it is very cold in winter, the water hyacinth plants die. In the next year, plants may regrow from seed. Hence, tests have been planned to see if the weevils can overwinter in Ningbo.

In 2001 the weevils will be introduced to Guangdong Province which is one of the areas in China most seriously affected by water hyacinth damage.

Besides the weevils, a bug, *Eccritotarsus catarinensis*, was introduced into China in the early spring 2000 from the Plant Protection Research Institute (PPRI), South Africa but, for unknown reasons, had not established its population after 4 months. BCI will introduce it again later. Pathogen surveys have also been started in Fujian and Zhejiang provinces in May 2000. Several promising isolates have been screened.

Integrated Control

In order to control the weed rapidly, an integrated control system was developed from 1996 by BCI scientists. Several herbicides, e.g. Roundup (41% IPA salt of glyphosate) and Caoganlin (10% salt of glyphosate), were screened to supplement the activity of the weevils. Bioassay tests showed that Roundup and Caoganlin had almost no adverse effect on the adults, pupae, larvae and eggs of the weevils. The tests of integrating Roundup at different concentrations with weevils indicated that herbicides had to be used at a lower concentration than normal, so as to not kill the plants too rapidly and not deprive the insects of food and habitat. The details of those tests were reported in the first IOBC water hyacinth workshop in Zimbabwe in 1998 (Ding et al. 1999).

Prospect

Water hyacinth is still a big problem in South China (even a new disaster in some areas) although great efforts have been made to control it in the past 10

years. As more and more attention from central and local governments is paid to improvement of the environment, control of water hyacinth is becoming one of their objectives. Biological control will be employed in more and more areas, but more effort still needs to be made to make the public and government officials aware of the important role that biological control can play in the solution of the weed problem.

BCI research on the biological and integrated control of water hyacinth will focus on the following subjects in the next few years by means of national and international collaborations:

- Study of the factors influencing the level of control of water hyacinth achieved by weevils, including the nutrients in the water body, lower temperatures in winter, natural enemies of the weevils, competition from other aquatic plants such as *Paspalum* species etc.
- Distribution of the weevils into more areas and introduction of new insects from abroad. An agreement between the South African and Chinese governments has been signed for collaboration on water hyacinth over the next three years. BCI will obtain help from PPRI for the importation of new natural enemies e.g. *Eccritotarsus catarinensis*.
- Conduct of field tests of integrated control on a large scale. The results from the tests in 1996–1998 on integrating herbicides with weevils will be verified and amplified on a large scale in the field in South China so as to modify the integrated management system.
- Continuation of the survey of pathogens in South China and introduction of promising fungi from abroad. More effort will be put into pathogen studies. In BCI a pathogen laboratory has been set up for the study of control of the weed by this means. China's strong background on developing biopesticides and bioherbicides in the past 40 years should help the laboratory to make good progress in the near future.

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