THE SEPIK SALVINIA PROBLEM IS BEATEN

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WHAT IS SALVINIA?

Salvinia molesta is a free floating water fern from South America. It reproduces only by vegetative means. New plants are formed by the division of the original one. The plant can grow rapidly and has been recorded as doubling every 2-3 days. Because salvinia can quickly cover fresh-water lakes with thick floating weed mats, it has caused problems in many tropical countries. The weed is present in several places in Papua New Guinea and has caused serious problems in the Sepik and Ramu rivers.

THE SALVINIA PROBLEM IN PAPUA NEW GUINEA

The Sepik River, which rises near Telefomin, follows a winding course through a wide floodplain for most of its 1150 km journey to the sea. This has resulted in the formation of many oxbow lagoons and shallow lakes. Salvinia is not a serious problem in the main river, as the strong current stops thick mats from forming. The main problems occur in the lakes and barats where still waters provide ideal conditions for the growth of the weed.

Salvinia is thought to have been introduced in 1971/1972. Since then, the weed has affected more than 500 km of lakes and at times covered 250 km^2 of water surface. This had a serious effect on the lives of the 40,000 people living the area. Villagers were not able to move about by boat or by canoe. The weed stopped them gathering traditional foods such as fish and sago. Children could not get to school or sick people to hospital. Access to markets was cut off and it was impossible to provide services or assistance from outside. There is an article describing the spread of sal-

Paddling a canoe through a thick mat of salvinia is not easy

-vinia in the Sepik and the problems it caused in HARVEST, Volume 5, No. 4.

Salvinia has also caused problems on a smaller scale in the Ramu river and on Waigani swamp. A very small infestation at Wau appears to have been eradicated by physical removal of plants from the water.

WHERE DID SALVINIA COME FROM?

Salvinia, as well as many other weeds, was almost certainly brought into Papua New Guinea by man. It was probably introduced as an aquarium plant by someone who did not know the problems it could cause. It

was seen in aquarium shops in Lae (1973) and in Port Moresby (1975). There is good evidence that salvinia was introduced to the Sepik in 1971/1972 by someone who lived near the river and had the plant growing in a fish tank.

By 1977, salvinia had become an obvious problem, and the government asked the United Nations Development Programme (UNDP) to help in finding a solution. A project coordinator was recruited by the UN Food and Agriculture Organization (FAO) and a joint PNG/UNDP/FAO control project began in 1981.

CONTROL METHODS

Three methods of control were tried:

1. Mechanical/Physical control

This mainly involved clearing of barats to help wind and currents flush salvinia from lakes into the main Sepik. Booms (floating fences) were built across barats and lakes to direct the flow of salvinia or to keep it in place to allow space for fishing, etc. This control measure was found to be quite useful but required a lot of labour and could only be used on certain lakes.

2. Chemical control

Spraying the weed with paraquat was found to be very effective as a short term measure, but was very expensive, costing K40 per hectare. Salvinia plants growing around the edges of lakes were sheltered by other vegetation and were not killed by the spray. Regrowth from these plants quickly covered the lakes once more. It was estimated that spraying would have to be carried out 3 times a year, and that this would cost about 1 million kina a year.

3. Biological control

When plants are taken from their native environment and introduced to a new one, they often do not have the natural enemies (insects and diseases) which would normally help to keep them under control. This is one of the reasons why plants such as salvinia can grow so quickly and become such a problem when they are introduced to new areas. Sometimes it is possible to introduce natural enemies to a country where a plant has become a weed, in the hope that they will bring it under control. This is called biological control. It is a long process, involving searches overseas and careful testing to ensure that the natural enemies will not damage any useful plants when they are released.

The salvinia control team knew that biological control offered the only chance for a cheap and permanent solution to the salvinia problem in the Sepik. Attempts at biological control of salvinia had already been made in several countries without much success. Then, in 1981 CSIRO in Australia successfully used a small South American weevil (beetle), *Cyrtobagous salviniae*, to control salvinia on Lake Moondarra in Queensland.

The weevil used to control salvinia - Cyrtobagous salviniae

THE INTRODUCTION OF *CYRTOBAGOUS*

In February 1982, 600 weevils were imported from Australia. They were released on Binatang lagoon, 10 km downstream from Angoram. To help them reproduce more quickly, the insects were concentrated in 2 floating cages, each enclosing 4 m^2 of salvinia.

By September 1982, when it was estimated that there should have been 4 generations of weevils, only 40 insects could be found in the cages! Clearly, the population was decreasing instead of multiplying. Samples

of salvinia tissue taken during this period showed that the plant was very low in nitrogen compared with plants from Lake Moondarra, where the weevils had been so successful.

A second release of 600 weevils was made into the cages, and each week, the salvinia in the cages was sprayed with a solution of urea fertilizer. This doubled the amount of nitrogen in the plants and the insects multiplied rapidly.

By December 1982 it was possible to take plants containing many insects from the cages and mix them with salvinia in the main lagoon. Surprisingly, although this salvinia was not fertilized, the insect population continued to multiply. What had happened?

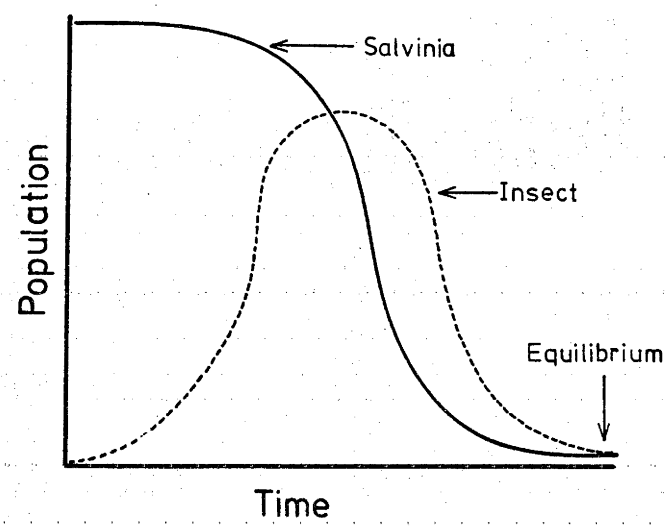
EFFECTS OF THE WEEVILS ON SALVINIA

Adult weevils feed on the buds of salvinia. Because the plant relies on vegetative reproduction, this slows both the growth of the plant and the production of new plants. *Cyrtobagous* larvae burrow inside the stem and interfere with the flow of nutrients. Leaves begin to die and eventually the whole plant rots and sinks.

As the insects damage the plant, nitrogen becomes more and more concentrated in the remaining live tissue. In addition, more nutrients are made available to the plant from the decay of salvinia already killed by the insects. With more nitrogen available, the insects lay more eggs and reproduce faster. Once the insects are established therefore, they actually improve the quality of their food supply and are able to multiply and spread rapidly.

SPREAD OF THE WEEVILS TO OTHER AREAS

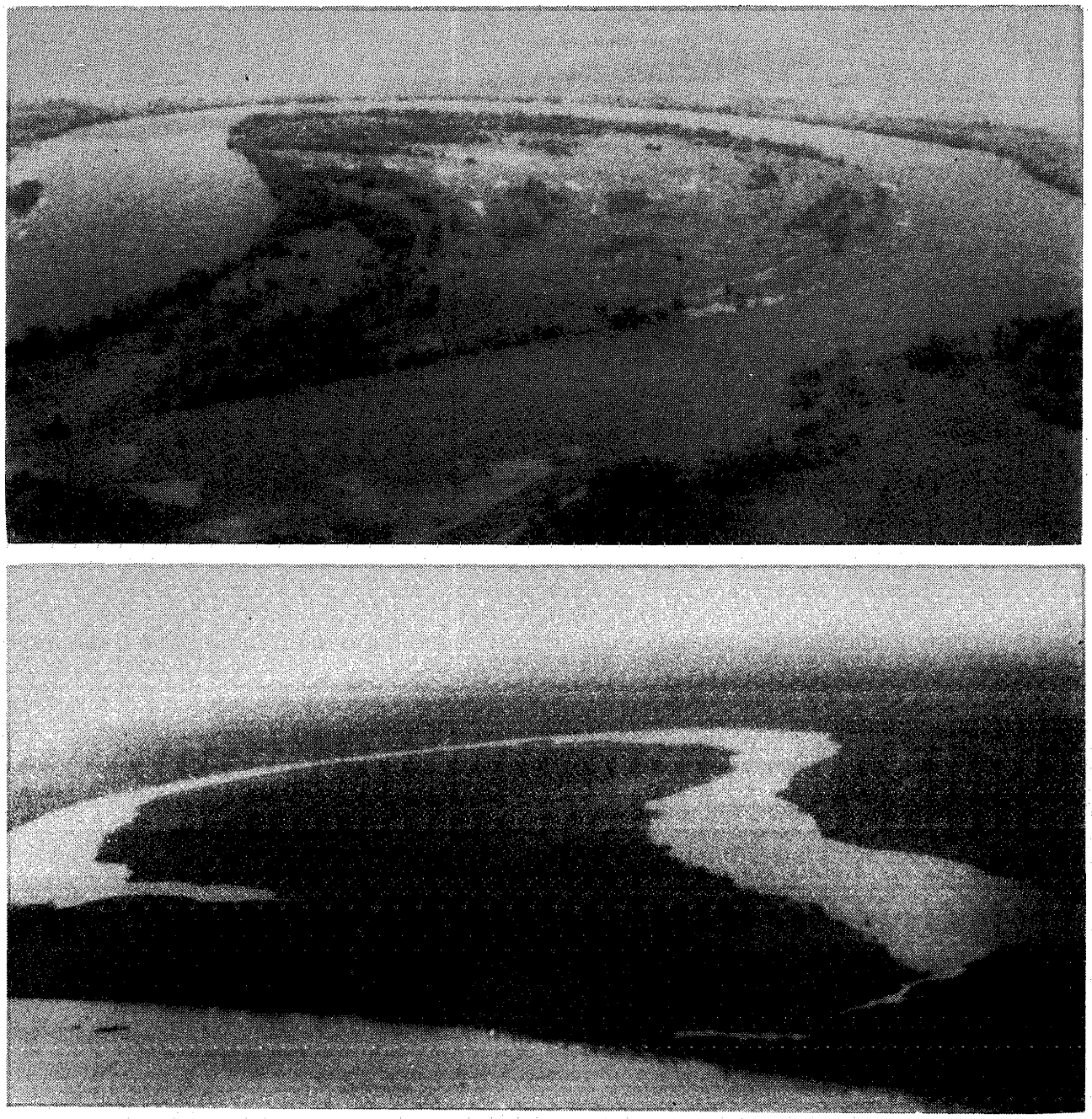
In May 1983, the control team was able to start spreading insects from Binatang lagoon to other problem areas. Weevil-infested salvinia was collected in copra sacks and carried by boat or canoe to new release sites where it was mixed with undamaged salvinia. Aircraft were used to carry sacks of weed from Angoram to Ambunti and from the Sepik to the Ramu. Over the next year, approximately 1 million weevils were distributed to new sites, where they quickly began to destroy the weed mats. By June 1985, less than 2 km^2 of salvinia remained in the Sepik and the weed was no longer a problem. Elsewhere in Papua New Guinea, the insects had also controlled salvinia in the Ramu river and on Waigani swamp.



Diagrammatic representation of the effects of Cyrtobagous *on the salvinia population*

As the graph shows, the amount of salvinia decreases as the insect population increases. However, because the weevils feed only on salvinia, they gradually use up their own food supply. When this happens, reproduction slows down and many insects starve - resulting in a population 'crash' Eventually an equilibrium (balance) point is reached where there is just enough salvinia to maintain the insect population at a very low level.

Some Sepik lakes have now been in this condition for 18 months, with only a few scattered salvinia plants growing around the edges of the lakes. This means that salvinia will never be completely eradicated, but there will be so little of it that it will no longer be a problem.



The top picture shows a lagoon in the Sepik River system which is almost completely covered with salvinia. The lagoon shown in the lower picture has been cleared of salvinia.

EFFECTS OF THE CONTROL PROGRAMME

People are able to collect sago again and report that they are catching many fish, both for their own use, and for sale in local markets. This, and other sources of revenue, such as crocodile hunting, means that school fees can be paid and that money is available in the villages. People can once more move about freely and have expressed their pleasure at the return of their traditional lifestyles after the problems which they have faced during the last 10 years.

FURTHER READING

Richards, A.H. (1979). Salvinia in the Sepik River. *Harvest* 5(4): 239-243.