War on water lettuce

Invasion and biological warfare in the Kruger National Park

The invasive alien plant, *Pistia stratiotes* (water lettuce), has been a problem in the Kruger National Park for over twenty years. Initially controlled chemically, a more environmentally friendly method of biological control has proved more effective. Photo: Llewellyn C. Foxcroft.

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Water lettuce (*Pistia stratiotes*) is alien to Africa and a declared weed in South Africa. The plant, originally from South America, is now found in tropical and subtropical areas throughout the world. Its spread was probably due to the popularity of this weed as a plant in water gardens, aquaria and as a medicinal plant. It now occurs at scattered localities throughout South Africa and unfortunately also in the Kruger National Park (KNP), especially along the Sabie River (in front of Lower Sabie Rest Camp) and on Sunset Dam near Lower Sabie. The N'waswitsontso River, from Orpen Dam down to the eastern boundary of the KNP, as well as the Levhuvu River and various pans in the Limpopo and Levhuvu flood plain, are also periodically invaded.

The negative effects of this alien plant are numerous. Dense mats cause deoxygenation of water bodies, reduced light penetration, increased siltation, increased water loss through evapotranspiration and block or inhibit fish movement. All these aspects lead to further problems as the complex ecological cycles are disrupted. The whole food chain in the aquatic environment is affected by dense infestations of this alien plant. For example, during dry periods the braided channels of the Sabie River become small pools which are important refuges for the more than ten species of fish which are found in that particular area, one of which is endemic to the Sabie River.

The main objective of the KNP is conserving indigenous biodiversity. This implies, where possible, preventing, reducing, minimizing and controlling any unnatural human-induced impact on the systems. The impact of biological invasions is regarded as one of the greatest threats to the biodiversity of the KNP. Internationally too, biological invasions are recognized by the IUCN as the second greatest threat to biodiversity globally, a close second to habitat degradation through activities such as de-forestation.

Chemical control

Chemical control with herbicides was employed to control water lettuce plants in the KNP on the Sabie River from Skukuza to the high level bridge, about 15 km downstream. For three years it was thought that the weed was under control, but then it had to be sprayed again, and thereafter annually – an extremely costly, labour intensive and dangerous undertaking. (There are lots of crocodiles and hippopotami in the dams and rivers!) Eventually financial limitations started affecting our ability to control the weed, and it became evident that it was not possible to eradicate it completely. A long-term, viable, cost-effective solution was needed.

Biological control success stories

In 1986, a host specific snout weevil, *Neohydronomus affinis*, proved effective in the control of water lettuce on the

The snout weevil, *Neohydronomus affinis*. This host-specific (which means it can only survive on its host plant and no other plant) insect lays its eggs on the water lettuce leaves and on hatching, the larvae bore into, and feed on, the internal spongy tissue of the leaves. Photo: Carina Cilliers.

Nhlangaluwe and Dakamila pans in the Pafuri region of the KNP. The weevil lays its eggs on the edge of the water lettuce leaves, and on hatching, the larvae bore into and feed on the internal spongy tissue of the leaves. The larvae pupate on the plant and after emergence the adults feed on the leaves causing small round holes. During the summer the total life cycle takes 25-30 days to complete. However, during the colder winter months, the life cycle takes longer to complete because insects are cold blooded and are affected by the lower temperatures. Fortunately, the growth of water lettuce also slows down in winter as the weather gets cooler. In spring the weevils become active and multiply quickly as temperatures increase, as does the water lettuce, providing more food for the hungry weevils. In this way the insect and plant populations track each another, with the weevil population mirroring, but slightly lagging behind, the plant populations' trends. In time, both populations will decrease. With biological control there will never be total eradication of the weed, but

there is a measure of control that is ecologically acceptable.

This weevil was released on the water lettuce in the **Sabie River at Lower Sabie** in 1987 and by 1992 this infestation was considered to be adequately under biological control. All chemical control on the Sabie River was stopped in 1993 and the bio-control agents maintain the plant populations at acceptable minimum levels.

The water lettuce infestation on **Sunset Dam** had been sprayed with herbicides for fifteen years, when in early 1992 it was noticed that the bio-control weevil also occurred on surviving plants there. In 1996 the costly chemical control of Sunset Dam was abandoned, and more weevils were released to boost the population. By spring 1997, Sunset Dam was completely clear of water lettuce! With this dramatic crash of its food resource, the insect population followed suite and weevil numbers dwindled, with only a few remaining on a remnant plant population. During summer the water lettuce population slowly built up and by late autumn and winter 1998, Sunset Dam was again completely covered in water lettuce. Nevertheless, the cycle repeated itself and by November 1998 the dam was again clear of water lettuce. This cycle of increasing and dwindling water lettuce cover on Sunset Dam (tracked by increases and decreases in weevil populations) was repeated annually until 2003.

But why was there such a high resurgence of the water lettuce when the weevils were obviously severely reducing them each year? The recurring colonization of the dam is largely due to the large store of water lettuce seeds that had accumulated in the mud at Sunset Dam. These seeds are long-lived and germinate each spring with up to 2 900 seedlings per square metre having been recorded. The annual re-growth, together with the seasonal growth, then became very apparent by the end of each summer and persist into autumn and winter when growth and reproduction of water lettuce plants and bio-control weevils slow down.

Intense pressure was put on management to start up chemical control of the water lettuce on the dam, a favoured sundowner spot for tourists, once more. Even internally there was not always agreement that biological control options would solve the problem, but it was generally accepted that the fluctuations would lessen and stabilize at some stage. It had taken six years to reach that stage on the Sabie River while on Sunset Dam it took seven years (1996-2003), with the dam becoming completely clear during 2004/05.

The same phenomenon occurred on **Orpen Dam**. Water lettuce persists in pools below Orpen Dam when the water in the dam dries up. As soon as water fills the dam again, water lettuce invades the dam with seedlings appearing and plants being moved upstream inadvertently by hippopotami and other means. In August 1999 it was thought that there were no bio-control agents on the water lettuce on this dam, but closer inspection revealed large numbers of beetles slowly eating and sinking the plants. The dam was clear of water lettuce by September 1999 and has remained so ever since.

Host-specific bio-control agents

Biological control has been practiced worldwide for 130 years, with approximately 274 agents having been released on various problem plants. In South Africa, seventy-three agents have been released on twenty-nine weed species, and nineteen agents have been released in and around the KNP.

The big question is, 'Will bio-control agents spread onto indigenous plants?' The answer is, ***no***. These agents are brought into the country under strict quarantine regulations and are extensively tested in quarantine to ensure that even in the event that there are no host food plants left, they will not disperse onto indigenous plants. This testing includes all plants related to the alien host plant and may take up to five years to complete. The weevil *N. affinis* is an example of a host specific, natural enemy of water lettuce plants.

Although many people were not convinced of the snout weevils' ability to control the water lettuce, especially on Sunset dam, this has been achieved through perseverance and the effects of this successful biological control will be long-term, sustainable and natural.

Should you require further information, please do not hesitate to contact Llewellyn Foxcroft at Skukuza on 013 735 4125, fax 013 735 4055, or email llewellynf@sanparks.org.

ABOVE: Before and after bio-control release on the Sabie River in the Kruger National Park. Photos: Carina Cilliers.

ABOVE: Before and after bio-control release on Sunset Dam in the Kruger National Park. Photos: Llewellyn C. Foxcroft.