First Attempt at and Early Results on the Biological Control of *Pistia stratiotes* L. in South Africa

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Although *Pistia stratiotes* L. (water lettuce) is not an important weed in the Republic of South Africa, the host-specific weevil *Neohydronomus pulchellus* Hustache was imported for the biological control of this weed. The weevil was released onto a dense infestation of *P. stratiotes* of several years standing on a pan in the Pafuri area in December 1985. By September 1986 the weevils had already destroyed most of the weed and in October 1986 the weed was under biological control at this site.

Key words: *Pistia stratiotes*, water lettuce, biological control, *Neohydronomus pulchellus*.

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Introduction

The free floating water lettuce, *Pistia stratiotes* L. (Araceae) is widespread in tropical and subtropical areas of the world and is still regarded as a serious weed in some African countries, India and South East Asia (Holm, Plucknett, Pancho & Herberger 1977; Wild 1961). In the Republic of South Africa it is not regarded as an important aquatic weed but it was declared a noxious weed in terms of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983), mainly as a preventative measure to stop the sale and distribution of this plant.

Pistia stratiotes has occurred in the low-lying subtropical areas of the Transvaal since 1953 when it was recorded on the Pafuri River. In Natal the earliest record was 1865 when it was found on the Umhlanga River; and since 1981 it has been recorded from only one locality (Gonubie) in the Cape Province (National Herbarium, Botanical Research Institute, Pretoria).

Pistia stratiotes has had a world-wide distribution for so long that its origin is not known with certainty (Holm *et al.* 1977), but *P. stratiotes* is probably of South American origin as most of its insect natural enemies are on record from this area (Bennett 1975). The biology and host specificity of one such natural enemy, *Neohydronomus pulchellus* Hustache (Coleoptera: Curculionidae) was studied on

water lettuce in Argentina by DeLoach, DeLoach & Cordo (1976). After exploratory studies in Brazil by entomologists of the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) the weevil, *N. pulchellus*, was imported into Australia in 1981 and released in 1982 after studies on its biology and host specificity confirmed its suitability as a biological control agent (Harley, Forno, Kassulke & Sands 1984).

This paper reports on the introduction and results obtained with *N. pulchellus* for the biological control of *P. stratiotes* at a study site in the Pafuri area in the Kruger National Park.

Methods and Materials

1. Host specificity

The usual range of host plants tested in Australia (Sands & Kassulke 1984) and those tested by DeLoach *et al.* (1976) met with the South African requirements for host specificity and permission to import and release *N. pulchellus* was obtained from the Directorate of Plant and Seed Control on the recommendation of the Director, Plant Protection Research Institute. A colony of 500 *N. pulchellus* was received from CSIRO, Brisbane in early December 1985, put through quarantine and released onto *P. stratiotes* on 18 December 1985 with permission of the Control Research Officer in the Kruger National Park.

2. Study site and plant measurements

In the Pafuri area in the Kruger National Park two pans were heavily infested with *P. stratiotes*. The weevil was released onto *P. stratiotes* at the Nhlangaluwe Pan and later introduced into the second pan DaKamila. Only the results obtained at Nhlangaluwe will be discussed.

An LSTATS program, P/Numobs was used to determine optimal sample size which allowed an estimate of number of plants and number of insect-damaged plants/m^2. One m^2 of plants was obtained by randomly counting and collecting plants in 10 squares in the plant mat. Measuring 30 plants/m^2 for rosette diameter proved statistically accurate.

Only on two occasions the plants from one m^2 were put into Berlese funnels to determine the number of adult beetles and afterwards the plants were dried and weighed. The funnels were calibrated as described by Boland & Room (1983).

Fixed point photographs were taken at each sampling date.

Results and discussion

Nhlangaluwe was approximately 50 m $\times$ 30 m in extent and water lettuce may have been there prior to, but definitely occurred on it since 1983. The water level in this pan fluctuated during the rainy season but usually, even in winter the water in the pan did not dry up completely (L. Hare, *pers. comm.*). Long term weather records for nearby Punda Maria indicated an average annual precipitation for this area of 572 mm and mean daily maximum and minimum temperatures of 28,9 °C and 16,7 °C. The hottest months were from October to March and the rainy season usually was from November to March (*Climate of South Africa*, Climate Statistics up to 1984, WB 40, Weather Bureau, Department of Environmental Affairs, Pretoria, 1986).

Fig. 1. Dense cover of free floating *Pistia stratiotes* on Nhlangaluwe Pan, Kruger National Park, 18 December 1985.

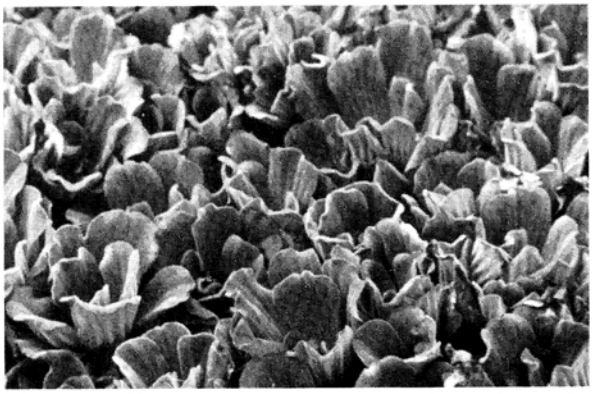

Fig. 2. Close-up of *Pistia stratiotes* infestation Nhlangaluwe Pan, Kruger National Park, 18 December 1985.

Table 1

Number of Pistia stratiotes *plants, mean rosette diameter and number of* Neohydronomus pulchellus *damaged plants/m² at Nhlangaluwe pan, December 1985 to September 1986*

Date	Plants/m²	Mean rosette diameter (cm)	Weevil damaged plants/m²
18 Dec. 1985	757	11,97	0
25 Feb. 1986	550	11,29	26
27 Jun. 1986	619	7,80	18
9 Sept. 1986	692	3,03	662

A dense mat of water lettuce covered the pan when the insects were introduced on 18 December 1985 (Figs. 1 and 2). The number of plants/m² was 757 and the mean diameter of a rosette 11,97 cm (Table 1). When the site was visited again on 25 February 1986 the weevils were well established at, and spreading from, the release point as judged by adult feeding marks and larval tunnelling. Of 550 plants in the one m² sample, 26 plants showed insect damage and mean rosette

diameter was 11,29 cm (Table 1). As the 1985/1986 summer proved dry the water level at Nhlangaluwe dropped sharply towards the end of March 1986, but rose again when late rain during April 1986 filled the pan (B. Pretorius, *pers. comm.*). On 27 June 1986 the number of plants/m^2 was 619, rosette diameter was 7,8 cm, and insect-damaged plants numbered 18 (Table 1). The count for insect-damaged plants at this stage may have been lower because the weevils were still spreading or sampling may have been between generations or because of slower breeding of the weevils in winter. On the penultimate visit on 9 September 1986 a drastic change had taken place at Nhlangaluwe. The number of plants/m^2 was 692, but these plants were small, mean rosette diameter was 3,03 cm, and the insect-damaged plants had increased to 662 (95,7%) (Table 1). The water level had again dropped because no rain had fallen since April 1986 but the remaining water lettuce covered approximately only one fifth of the remaining water surface. In Figures 3 & 4 the edge of the remaining water lettuce and the general appearance of the mat is shown. Only on the last two visits was the number of adult weevils counted/m^2 and the dry plants weighed. In June the dry plants from one m^2 weighed 226 g and in September 138 g, while three adult weevils were extracted in June and 37 in September. By the second week of October 1986 all water lettuce plants had sunk and because of the persistent drought the water level was also dropping fast (L.

Fig. 3. Reduction of *Pistia stratiotes* due to the action of the weevil *Neohydronomus pulchellus*. Nhlangaluwe Pan, Kruger National Park, 9 September 1986.

Fig. 4. Close-up of sparse *Pistia stratiotes* at Nhlangaluwe Pan, Kruger National Park, 9 September 1986.

Hare and S.C.J. Joubert, *pers. comm.*). On the last visit on 22 October 1986 only a narrow stream of water was running through the bed of the pan, there were no water lettuce plants in the stream or any sign of either rooted plants or plant remains in the mud. When the water level had previously dropped plants had rooted in the wet mud.

Conclusion

After the control obtained by *N. pulchellus* of *P. stratiotes* in Australia, Harley *et al.* (1984) suggested that the weevil would probably also affect similar control in Africa. At Nhlangaluwe it was demonstrated that biological control of *P. stratiotes* with *N. pulchellus* can be obtained in South Africa in a remarkably short time.

Water lettuce regrowth from seed is likely to occur, but provided that some plants, supporting a remnant weevil population remains in isolated pans, recurrence of dense infestations is unlikely, judging by present results.

Water lettuce infested with *N. pulchellus* larvae and adults was introduced to the nearby DaKamila Pan and from there the weevil will eventually be redistributed to the infestation on the Sabie River which should then lead to the biological control of the alien plant, *P. stratiotes*, in the Kruger National Park.

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