SHORT COMMUNICATION

First report of establishment of two weevils, *Neochetina bruchi* Hustache and *Neochetina eichhorniae* Warner (Coleoptera: Curculionidae), released against water hyacinth [*Pontederia crassipes* Mart.] in the Philippines

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Received: 18 September 2023

Accepted for publication: 24 October 2023

Published: 30 December 2023

Abstract

Water hyacinth, *Pontederia crassipes* Mart. [syn. *Eichhornia crassipes* (Mart.) Solms.] of the family Pontederiaceae, is one of the world's worst aquatic weeds and a major problem in the Philippines, covering lakes, and blocking drainage and irrigation canals. Two weevils *Neochetina bruchi* Hustache and *N. eichhorniae* Warner (Coleoptera: Curculionidae) were introduced into the Philippines in 1992 to help control this weed. However, their establishment has never been confirmed.

In 2014, *P. crassipes* infestations at Laguna de Bay and Sampaloc Lake, San Pablo City were inspected but there were no signs of the beetles' presence, as indicated by distinct feeding scars. During weed surveys north of Manila during February 2023, feeding scars typical of *Neochetina* spp. were seen at San Quintin, Pangasinan although no beetles were seen. However, at several other sites, namely Baler, San Jose, Maria Aurora and Pulong Bahay, both *N. bruchi* and *N. eichhorniae* were found. To our knowledge, this is the first official record of both weevils establishing on *P. crassipes* in the Philippines and gives prospects to the biological control of this weed in the country. Sets of both weevils have been deposited at the Museum of Natural History, University of the Philippines at Los Baños, Philippines.

Introduction

Water hyacinth, *Pontederia crassipes* Mart. (Pontederiaceae) is one of the world's worst aquatic weeds, being found in over 80 tropical and subtropical countries throughout Africa, Asia and Oceania. It has also been reported in numerous countries in North America, particularly in the Caribbean (CABI, 2013). In the Philippines, *P. crassipes* is one of five major aquatic weeds (Bravo, 1991), covering lakes and hindering fishing activities, as well as blocking irrigation canals and drainage ditches, which can increase the risk of flooding.

Large infestations of *Pontederia crassipes* can lead to a decrease in oxygen content in water bodies, displacement of native aquatic plant species and reduced species diversity. In addition, it can also cause severe human health impacts by promoting diseases, such as malaria and dengue fever by creating suitable habitats for mosquitoes (Julien *et al.*, 1999). There are particularly large infestations in Laguna de Bay, especially near Taguig City (Figure 1A, B) and numerous infestations in Sampaloc Lake and in the Aurora region (Figure 2A, B).

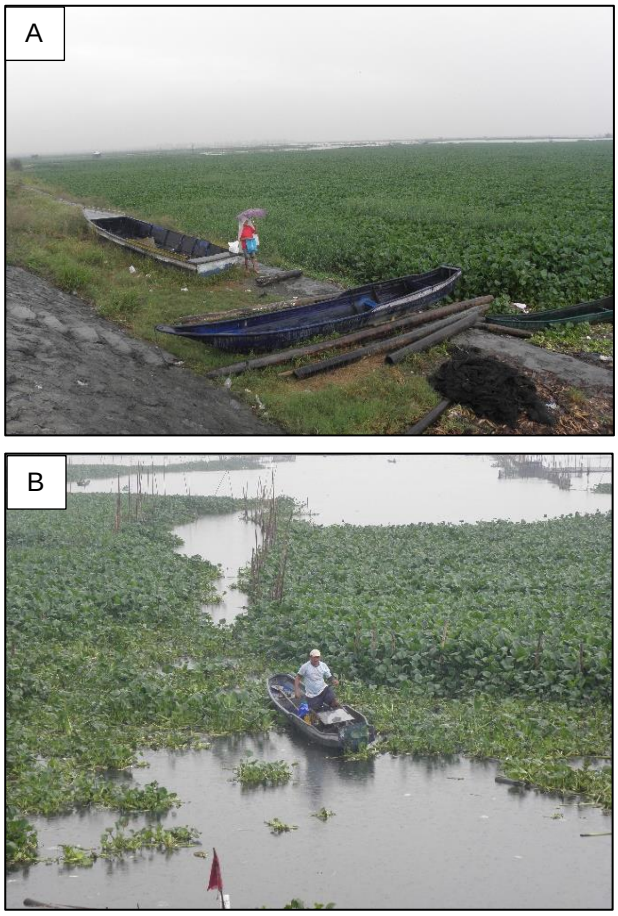

Figure 1. *Pontederia crassipes* infestations in the Philippines: Laguna de Bay (A & B)

Managing *P. crassipes* is particularly difficult as the plants grow very fast, doubling its biomass in 2-3 weeks, making manual control not feasible. The use of herbicides is also prohibitive in most waterbodies due to the effect of chemicals on water quality and fishing areas. With either manual removal or the use of herbicides, there is also the issue of viable seeds left in the muddy soil and reinfestation through daughter plants and fragments, which can take root and re-establish populations (Gopal, 1987; Wright and Purcell, 1995; Julien *et al*., 1999).

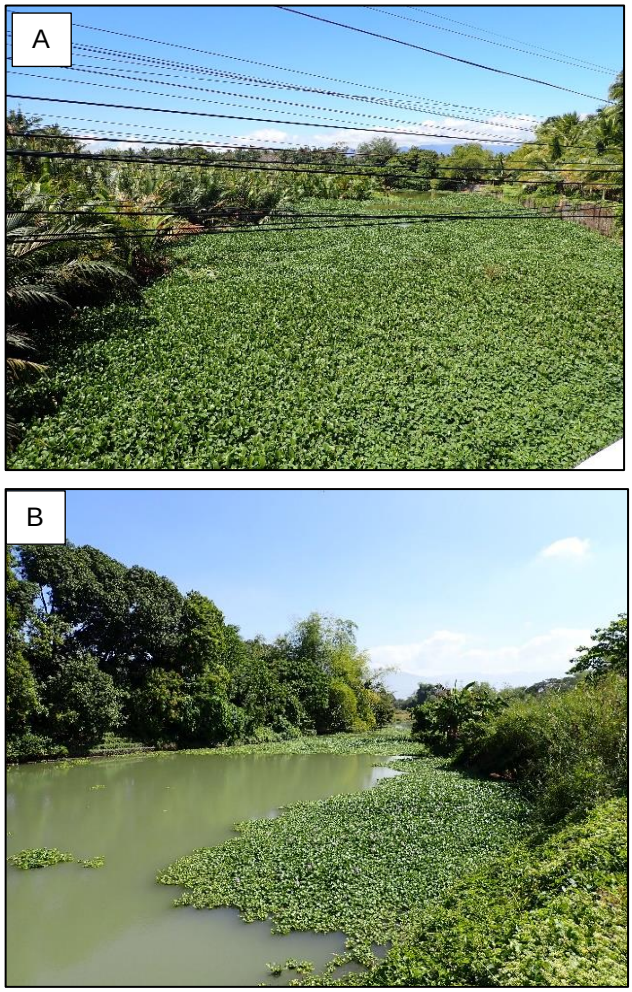

Figure 2. *Pontederia crassipes* infestations Pudoc Bridge, Baler-Casiguran Road Baler (A) and San Quintin, Pangasinan (B)

In 1992, two weevils, *Neochetina bruchi* Hustache and *Neochetina eichhorniae* Warner (Coleoptera: Curculionidae) were deliberately introduced into the Philippines by the Bureau of Plant Industry, Department of Agriculture from Thailand, where they had been released and established earlier. Both weevils were released in Laguna de Bay, as well as at unrecorded sites on Mindanao (Julien, 2001; Winston *et al*., 2014).

Establishment was never confirmed at any site in the Philippines and opportunistic field surveys at Laguna de Bay and Sampaloc Lake, San Pablo City by the first author in 2014 and 2019 failed to find signs (adult feeding scars) of establishment. Enquiries with researchers at several universities and government agencies could also not confirm the establishment of either weevil.

During surveys of several weed species in February 2023, opportunistic inspections of several *P. crassipes* infestations were conducted and the results of those surveys of *P. crassipes* in regions north of Manila are reported.

Results of Recent field inspections of Water Hyacinth

During a two-week visit to the Philippines in February 2023, funded by the New Zealand Government and managed by Manaaki Whenua - Landcare Research, looking for potential natural enemies of several invasive weed species, including *Decalobanthus peltatus* (L.) A.R. Simões & Staples (Convolvulaceae), *Solanum torvum* Sw. (Solanaceae) and *Urena lobata* L. (Malvaceae), opportunistic surveys were conducted on several other weed species, including *P. crassipes*, where biological control agents had previously been released and could be present.

The field surveys started in Clark, travelling north to Baguio, west to the coastal towns of Santo Tomas and San Fernando, east to Baler and Dinadiawan and south to Balanga, Mariveles, Bagac and Subic Bay. *Pontederia crassipes* was found at six sites (Table 1; Figure 3). *Neochetina eichhorniae* was found at three sites, while *N. bruchi* was found at only one site (Table 1).

The two weevil species (both about 4-5 mm long) can be distinguished from each other quite easily, with *N. bruchi* being usually brown in colour and possessing a chevron and two small parallel markings on the elytra, while *N. eichhorniae* is usually grey in colour, has two long parallel markings on the elytra but does not possess a chevron (Figure 4A).

Table 1. Sites during weed surveys where *P. crassipes* was observed and the presence or absence of both *Neochetina* spp.

Date	Site details	GPS location	Species present	Notes
21 Feb. 2023	Principe Bridge, Agoo, La Union	16.32897°N, 120.36595°E	Nil	Damage by grasshoppers
23 Feb. 2023	San Quintin, Pangasinan	15.95996°N, 120.74542°E	Undetermined	Feeding scars only
24 Feb. 2023	Baler-Casiguran Road, near Baler	15.77002°N, 121.55653°E	*N. eichhorniae*	Slight impact
26 Feb. 2023	Pantabangan-Baler Road, San Jose, Maria Aurora	15.78617°N, 121.47966°E	*N. eichhorniae*, *N. bruchi*	Slight impact
26 Feb. 2023	Pantabangan-Baler Road, San Jose, Maria Aurora	15.77396°N, 121.48398°E	Undetermined	Could not access site
27 Feb. 2023	Guimba-Aliaga Road, Pulong Bahay, Nueva Ecija	15.53860°N, 120.82439°E	*N. eichhorniae*	Slight impact

At the sites where the weevils were present, adult feeding scars were obvious and common (Figure 4B). However, despite the presence of larvae in the crown of plants (Figure 5), physical damage to plants by larvae appeared to be only slight.

Many of the plants at sites with beetles present were still quite tall (up to about 700 mm) and did not appear to show any signs of dieback, as usually seen when damage by the beetles is significant.

At one site in San Quintin, feeding scars were seen on several lamina but no weevils were recovered. As the feeding scars by both species (Figure 4B) are similar, it was not possible to determine which weevil species were present. Larvae of both species are indistinguishable in the field and feed in the crown of the plants (Figure 5), which can make plants water-logged and sink.

At some other sites where *P. crassipes* was found, there were no signs of damage by the weevils or plants were not accessible for a closer examination to determine if weevils were present (Table 1).

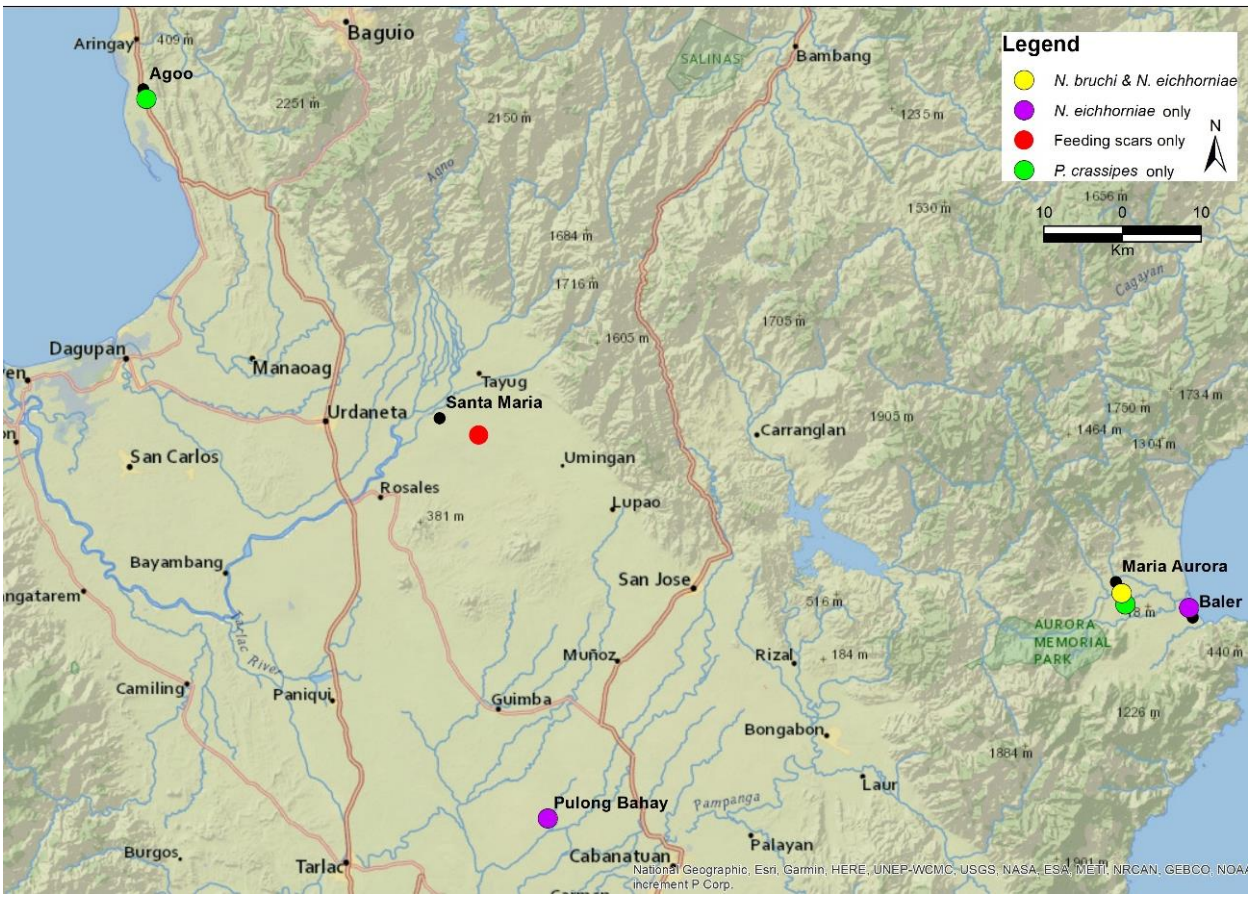

Figure 3. Map showing sites where *P. crassipes* was found, as well as where *N. bruchi* and *N. eichhorniae* were observed.

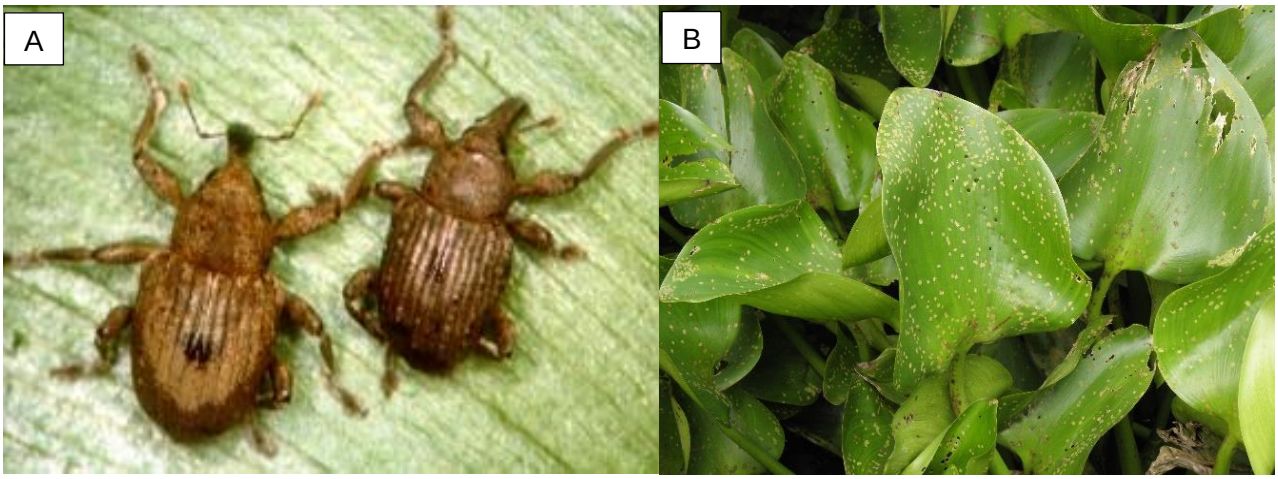

Figure 4. *Neochetina bruchi* (L) (orange arrows indicating chevron and parallel markings) and *N. eichhorniae* (R) (A), adult beetle feeding scars (B)

Discussion

The two weevils, *N. bruchi* and *N. eichhorniae* are recorded for the first time in the Philippines. These biological control agents were introduced in 1992 to control *P. crassipes* but their establishment had never been confirmed (Julien, 2001; Winston *et al*., 2014), prior to the current surveys. *Neochetina bruchi* has been deliberately introduced into 41 countries, with establishment now confirmed in 37 countries, while *N. eichhorniae* has been deliberately introduced into 43 countries, with establishment now confirmed in 39 countries (Winston *et al*., 2023).

Figure 5. Larvae tunnelling into the crown of *P. crassipes* plants

The impact of the two weevils on *P. crassipes* in these countries ranges from slight to high, with better control of the weed achieved if both species are present. In some countries e.g., Papua New Guinea and Vanuatu, biological control of *P. crassipes* has been particularly successful at some sites (Julien and Orapa, 2000; Day and Bule, 2016). However, in most other countries, detailed assessments of the beetles' impact on *P. crassipes* have not yet been conducted.

One of the factors that may limit successful biological control is the eutrophication of water ways, with levels of control by the beetles generally lower in heavily polluted waterways. It appears in these systems, *P. crassipes* can grow more vigorously and thus may outgrow any damage caused by weevils (Coetzee and Hill, 2011). This was particularly evident in Zimbabwe, where weevil numbers were high, but plants appeared to be quite healthy and still forming dense infestations.

In the Philippines, *P. crassipes* grows in natural lakes, as well as streams, irrigation canals and drainage systems. Only a few of these sites have been assessed for the presence of the weevils. Since the sites covered in the current surveys were only visited once, it is not possible to provide any meaningful long-term impact of the weevils on *P. crassipes* populations at the sites visited to date. It would be beneficial if further surveys could be conducted to determine the distribution of *P. crassipes* in the Philippines and to determine the presence and impacts of one or both of the weevils at these sites.

Weevils could be introduced to sites where they are not present and longer-term studies could be undertaken to assess the impact of the weevils on *P. crassipes* in the Philippines.

Where weevils are already present and *P. crassipes* is not under adequate control, other biological control agents against *P. crassipes* that have been tested for specificity and have established in other countries could also be introduced (Winston et al., 2023).

Acknowledgements

The authors offer their sincere thanks to Brad S. Gray, Queensland Department of Agriculture and Fisheries, who prepared the map.

References

Bravo, M. V. A. (1991). Aquatic weeds in the Philippines: a general assessment of scenario. *BIOTROP Special Publication*, No.40: 47-49.

CABI. (2013). *Eichhornia crassipes* (water hyacinth). Datasheet. CABI Compendium **https://doi.org/10.1079/cabicompendium.20544** (Accessed: 27 July 2023).

Coetzee, J. A. and Hill, M. P. (2011). The role of eutrophication in the biological control of water hyacinth, *Eichhornia crassipes*, in South Africa. *BioControl*, 57: 247-261.

Gopal, B. (1987). *Water hyacinth*. Elsevier Science Publishers, Amsterdam, Netherlands. p 471.

Julien, M. H. (2001). Biological control of water hyacinth with arthropods: A review to 2000. In: Julien, M. H., Hill, M. P., Center, T. D. and Jianqing, D. (Eds.). *Biological and Integrated Control of Water Hyacinth, Eichhornia crassipes*: *Proceedings of the Second Meeting of the Global Working Group for the Biological and Integrated Control of Water Hyacinth*. Beijing, China, 9–12 October 2000. ACIAR Proceedings No. 102, Canberra. pp. 8-20.

Julien, M. H., Griffiths, M. W. and Wright, A. D. (1999). Biological control of water hyacinth: The weevils Neochetina bruchi and N. eichhorniae: biologies, host ranges, and rearing, releasing and monitoring techniques for biological control of Eichhornia crassipes. ACIAR Monograph No. 60, Canberra. p. 86.

Julien, M. H. and Orapa, W. (2000). Successful biological control of water hyacinth (*Eichhornia crassipes*) in Papua New Guinea by the weevils *Neochetina bruchi* and *Neochetina eichhorniae* (Coleoptera: Curculionidae). In: Spencer, N. R. (Ed.). *Proceedings of the X International Symposium on Biological Control of Weeds.* Montana State University, Bozeman, Montana, USA. pp. 138-139.

Winston, R. L. et al. (Eds.). (2014). *Biological Control of Weeds: A World Catalogue of Agents and Their Target Weeds*, 5th Edition. USDA Forest Service, Forest Health Technology Enterprise Team, Morgantown, West Virginia. FHTET-2014-04. p. 838.

Winston, R. L. et al. (Eds.) (2023). *Biological Control of Weeds: A World Catalogue of Agents and Their Target Weeds*, 5th edition. USDA Forest Service, Forest Health Technology Enterprise Team, Morgantown, West Virginia. FHTET-2014-04 (**https://www.ibiocontrol.org/catalog/**) (Accessed: 5 April 2023).

Wright, A. D. and Purcell, M. F. (1995). *Eichhornia crassipes* (Mart.) Solms-Laubach. In: Groves, R. H, Shepherd, R. C. H. and Richardson, R. G. (Eds.). *The Biology of Australian Weeds*. R.G. and F. J. Richardson, Melbourne. pp. 111-122.