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First record of *Pistia stratiotes* (water lettuce) from Gilan province (North of Iran)

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Abstract

In order to study the conservation status of the plant species and ecosystems of Gilan province (North of Iran), an alien species was observed in some ponds in the east of Rasht, which covered the surface of ponds. The plant samples were collected and photographed; also the relevant environmental data were recorded in situ. The collected specimens were studied with various scientific resources and led to the identification of the species as *Pistia stratiotes* which is commonly known as "water lettuce". This species is recorded for the first time from Iran. The plant is pan-tropical and is considered to be one of the most widely distributed aquatic invasive plants in the world. The paper presents data on taxonomic remarks of this plant along with some notes on its geographical distribution and habitat. This report also highlights the need for implementing early control measures with special emphasis on all freshwater habitats in the northern parts of the country.

Keywords: Alien plant, *Araceae*, distribution, flora of Iran, pond

نخستین گزارش گونه *Pistia stratiotes* (کاهوی آبی) از استان گیلان

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خلاصه

در بررسی جهت تعیین جایگاه حفاظتی گیاهان و بوم‌سازگان‌های استان گیلان، یک گیاه آبزی بیگانه در آب‌بندان‌های شرقی شهر رشت مشاهده شد که سطح آب را پوشانیده بود. نمونه‌هایی از گیاه جمع‌آوری و همچنین اطلاعاتی از شرایط رویشگاهی آن تهیه گردید. نمونه‌های موجود به کمک منابع فلوری معتبر مورد مطالعه قرار گرفتند و در نتیجه گیاه *Pistia stratiotes* L. با نام عمومی کاهوی آبی متعلق به تیره گل‌شیپوری (*Araceae*) شناسایی شد که در اینجا برای نخستین بار از ایران گزارش می‌شود. کاهوی آبی گیاهی حاره‌ای است که امروزه به شکل مهاجم پراکنش گسترده‌ای در جهان پیدا کرده است. به این ترتیب با اعلام امکان گسترش وسیع گونه فوق، لزوم اتخاذ تدابیر کنترلی سریع با تاکید بر کلیه زیستگاه‌های آب شیرین شمال کشور توصیه می‌گردد.

واژه‌های کلیدی: آب‌بندان، پراکنش، تیره گل‌شیپوری، گیاه بیگانه، فلور ایران

Introduction

Pistia stratiotes L. belongs to tribe *Pistieae* within family *Araceae* (Mayo *et al*. 1997, Huber *et al*. 2013). This plant which is commonly known "water lettuce" is a monotypic genus. It has a worldwide distribution, occurring on all continents except Antarctica (Azim Khan *et al*. 2014). In tropical and sub-tropical climates, it is perennial while in temperate regions, the plant has an annual life form (Parsons & Cuthbertson 2001). *Pistia* grows in freshwater lakes, ponds, slow-moving rivers, reservoirs and ditches (Chapman *et al*. 2017). It is worth mentioning that, the plant can survive in ephemeral waters which are subject to seasonal drying by anchoring to the hydro-soil when the water level recedes (CABI 2019).

Most of the problems associated with "water lettuce" are due to its rapid growth rate and tolerance varying environmental conditions (Živković *et al*. 2019). Since 1960s, "water lettuce" has been noted as a troublesome aquatic plant (Sculthorpe 1967) and considered as a serious weed in more than 40 countries (Holm *et al*. 1977). It often invades the native hydrophytes in wetlands and rice paddies (Marwat *et al*. 2010) competing with existing plants which finally leads to overcome them (Marwat *et al*. 2010, Chapman *et al*. 2017). Another negative impact of this plant is it's causing effects on human health which provides a suitable habitat for the vectors of malaria mosquitoes (Lounibos & Escher 1985).

Besides its invasiveness on aquatic ecosystems, this plant is widely used as an aquarium plant (Christenhusz *et al*. 2017), heavy metals absorber (Thilakar *et al*. 2012), chemical products, medicinal uses, and for urban sewage treatment. It is also used as livestock feeding (Azim Khan 2014).

Materials and Methods

In a field expedition to Gilan province (North of Iran), large numbers of aquatic plants were collected and encountered free-floating species in Lishavandan and Molasara ponds in the east of Rasht (North of Iran). The complete specimens were collected and photographed in Sept. 2019. The collected plants deposited in the Gilan Agricultural and Natural Resources Research Center (Rasht). The relevant environmental data were also recorded *in situ* and water samples were collected for chemical analysis. The specimens were studied with various floras and relevant literature (Riedl 1969, Mayo *et al*. 1997, Heng *et al*. 2008, Huber *et al*. 2013, WCSP 2019).

Result indicated that, the new plant was *Pistia stratiote* and it has not been so far officially reported to the Iranian flora. Worldwide geographical distribution was also examined through reliable sources (GBIF 2018, Chapman *et al*. 2017) (Fig. 1).

Results

- Taxonomy

Pistia stratiotes L., Sp. Pl.: 963 (1753), Fig. 2

Syn. *Zala asiatica* Lour. (1790); *Pistia spathulata* Michx. (1803); *P. crispata* Blume (1836); *P. leprieuri* Blume (1836); *P. linguiformis* Blume (1836); *P. minor* Blume (1836); *P. occidentalis* Blume (1836); *P. aegyptiaca* Schleid. (1838); *P. commutata* Schleid. (1838); *P. obcordata* Schleid. (1838); *P. horkeliana* Miq. (1845); *P. africana* C.Presl (1851); *P. amazonica* C.Presl (1851); *P. weigeltiana* C.Presl (1851); *P. turpinii* K.Koch (1852); *Apiospermum obcordatum* (Schleid.) Klotzsch (1853); *Limnonesis commutata* (Schleid.) Klotzsch (1853); *L. friedrichsthaliana* Klotzsch (1853); *Pistia aethiopica* Fenzl ex Klotzsch (1853); *P. brasiliensis* Klotzsch (1853); *P. cumingii* Klotzsch (1853); *P. gardneri* Klotzsch (1853); *P. natalensis* Klotzsch (1853); *P. schleideniana* Klotzsch (1853); *P. texensis* Klotzsch (1853); *P. stratiotes* var. *cuneata* Engl. (1878); *P. stratiotes* var. *linguiformis* Engl. (1878); *P. stratiotes* var. *obcordata* (Schleid.) Engl. (1878); *P. stratiotes* var. *spathulata* (Michx.) Engl. (1878).

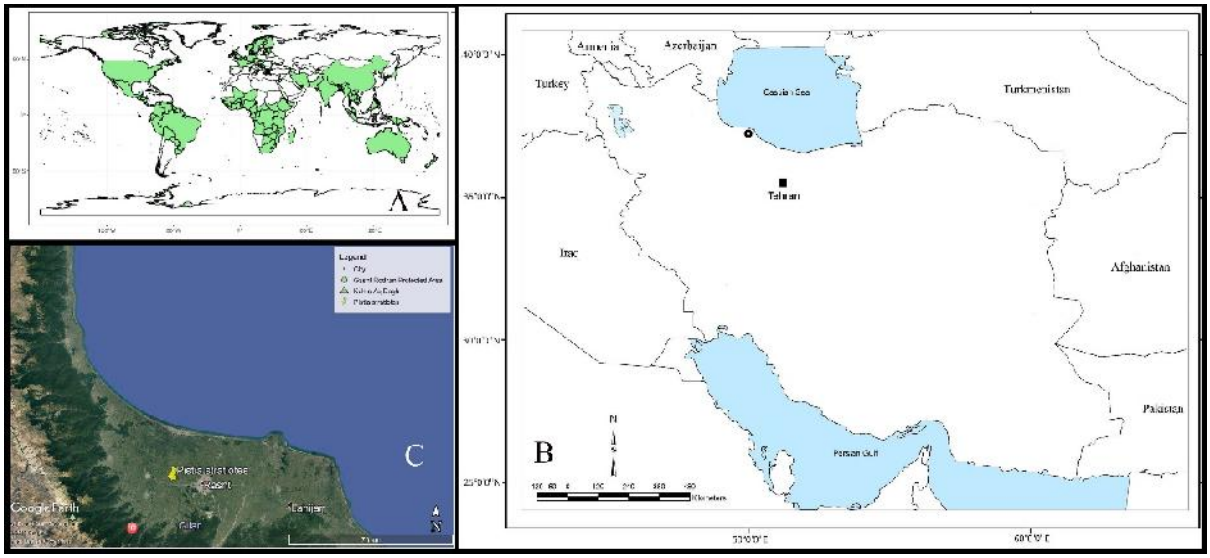

Fig. 1. Distribution of *Pistia stratiotes*: A. In the world, B. In Iran, C. In Gilan province.

Free-floating herbs, stoloniferous, acaulescent, with submerged feathery roots. Leaves several in a rosette, pubescent, 6–9 × 2–6 cm; petiole very short; sheath ligulate, ligulate to 1 cm long, very thin, scarious; leaf blade obovate-cuneate to obovate-oblong; veins subparallel, strongly prominent abaxially. Inflorescence spadix, somewhat constricted centrally, much shorter than leaves; Spathe pubescent outside and glabrous inside, up to 1.3 cm long, proximal margins connate with ovary wall forming tube, free margins folded, forming a partition; male organ on distal chamber and female organ located proximally; limb erect, acute. Spadix shorter than spathe, mostly adnate to spathe, at base female zone with single gynoecium; male zone with a single whorl of 2–8 flowers, consisting of a thin, marginally lobed, green, annular flap. Flowers unisexual, naked. Gynoecium obliquely adnate to spadix axis; ovary ovoid; stylar region attenuate. Male flower a synandrium consisting of two connate stamens. Fruit thin-walled, multi-seeded with irregularly breaking up ellipsoid berry. Seed barrel-shaped.

Specimen examined: Iran: Gilan province, Rasht-Sowme'eh Sara, Lishavandan and Molla Sara lagoon, 37º 16´30˝ N, 49º 25´ 29˝ E -8 m a.s.l., 20 Sept. 2019, M. Bidarlord (IRAN 76846).

Pistia stratiotes was observed in ponds with a water depth up to 1.5 m while no associated species were observed with this plant. Comparing all floras of ponds showed that, the new weed was dominant in interference with natural flora of aquatic ecosystems in the area and almost all indigenous plants such as *Ceratophyllum demersum*, *Nymphoides cristata* (Roxb.) Kuntze, *N. indica* (L.) Kuntze, *Nymphaea alba* L., and *Wolffia arrhizal* (L.) Horkel ex Wimm., were facing with eradication in presence of this new weed. From the pond water sample, pH, EC, phosphorus, potassium, chlorine, and calcium were measured (Table 1).

Fig. 2. *Pistia stratiotes*: A. Habitat, B. Plants, C. Ligule, D. Stolon, E. Leaf in adaxial side, F. Spathe, G. Spadix (male and female flowers along with their position), H. Female flower, K. Male flowers (Bar = 4 mm).

Table 1. Values obtained from chemical analysis of *Pistia stratiotes* habitat

pH	EC	P	K	Ca	Mg	Cl
7.3	0.838 DS/M	1.5 ppm	5.2 ppm	2.2 m E/L	2.1 m E/L	2.1 m E/L

Discussion

Human have effectively transported thousands of species around the world (Havel *et al.* 2015). The main potential pathway that introduces *Pistia stratiotes* in the flora of Iran is as an ornamental plant or the disposal of aquarium material. Due to favorable living conditions in northern Iran, it has been able to invade the natural habitats and expand its distribution.

Pistia stratiotes could replace the native hydrophytes in ponds and other water reservoirs (Marwat *et al*. 2010). Growth in dense mats on the surface of the water bodies and the production of allopathic chemicals (Aliotta *et al*. 1991) by this plant are the main potential contributors to remove of associated species at the ponds. It should also be mentioned that, the measured water factors of growth ponds were close to the adjacent ponds. *Pistia stratiotes* and native plant both grow on separate sides of a pond. This plant can be one of the most problematic plants in Iranian wetlands in the future, similar to other invasive plants such as *Azolla filiculoides* Lam. (Hill 1999), and *Eichhornia crassipes* (Mart.) Solms (Mozaffarian & Yaghoubi 2015). By comparing the results of water analysis with previous literature (Mayo *et al*. 2009, Živković *et al*. 2019), it is concluded that, the plant grows in a very wide variety of aquatic habitats.

The most ideal method to avoid "water lettuce" is prevention of its introduction to new areas which requires a lot of public awareness. Water lettuce can be controlled by chemical, mechanical and biological means (CABI 2019). Physical removal (hand removal) is recommended for small infestations. This method is more commonly used for the early infestations of this plant in north of Iran. Due to environmental concerns, the chemical and biological methods should be done cautiously (Hill 2003). Investigations in freshwater plants in Gilan province showed that, this plant has not yet been widely-dispersed in the region and can be easily controlled and managed in the present conditions.

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