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ASSESSMENT OF IMPACTS OF INVASIVE ALIEN PLANT SPECIES (IAPS) ON ECOLOGICAL DIVERSITY ALONG THE SAIGON RIVER, VIETNAM

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ABSTRACT

Invasive alien plant species (IAPS) have become a threat to biodiversity on a global scale. The assessment and analysis of the impacts of IAPS on the ecosystem are essential in the management of invasive alien species. In this study, we determined the influences of IAPS on the natural ecosystem along the Saigon River, which flows through Cu Chi and Hoc Mon districts, Ho Chi Minh City, Vietnam. Evaluation of the dispersal of IAPS and other possible causes leading to the degradation of the Saigon riverine ecosystem were identified. Two species of higher plants dispersing along the riverbanks found and analyzed in this paper are *Mimosa pigra* L. and *Eichhornia crassipes* (Mart.) Solms (these two IAPS are both native to tropical America). This investigation applied the survey method by line, measured the number of individuals, and calculated the coverage of IAPS. Research showed that *Mimosa pigra* L. existed mostly in the study area as small populations, the *Mimosa pigra* L. area dispersed into large populations, which has greatly reduced biodiversity in that place. *Eichhornia crassipes* (Mart.) Solms developed to form large and thick layers that obstructed waterway navigation, and partially affected the water body where *Eichhornia crassipes* (Mart.) Solms appeared. From the status of IAPS in the study area, we also proposed measurements to manage biological encroachment, to conserve and sustainably develop riverine ecosystems.

Keywords: Invasive Alien Plant Species (IAPS), Biological Diversity, Ecosystem, *Mimosa Pigra* L., *Eichhornia Crassipes* (Mart.) Solms.

I. INTRODUCTION

Bioinvasion occurs when a species invades and settles in a new environment [1]. It alters the populations of other species already settled there, as well as affects the balance of plant and animal communities [2]. People have realized the spread and invasion of species [3], affecting negatively (as well as positively) human development and the natural world of animals, plants, and microorganisms [4], [5].

II. METHODS

2.1. Method of determining the coverage of *Mimosa pigra* L.

Counting all the individuals of *Mimosa pigra* L. from the designated area was based on the principle of measuring the coverage toward the two directions: North-south and West-east. A tape measure was used to calculate the coverage of each tree (if growing alone) or tree bush (if the trees grow into bushes).

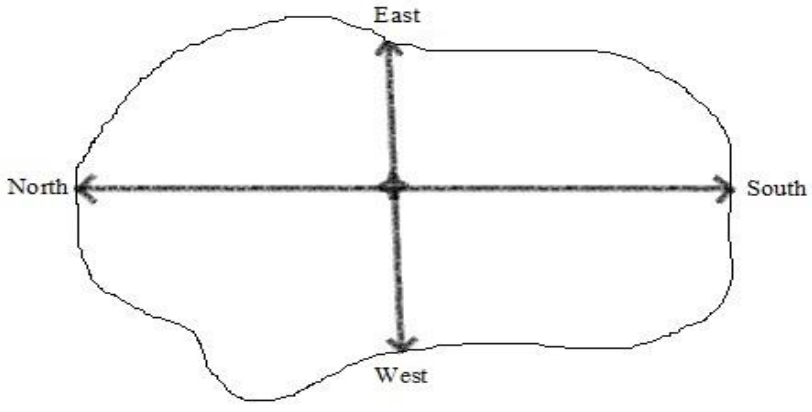

Figure 1. Measuring method of the coverage of *Mimosa pigra* L.

The presence of *Mimosa pigra* L. individuals was assessed as 5 levels (**Table 1**):

Table 1. Plant distribution level

Level	Distribution form
1	Grow alone
2	Grow into bushes
3	Grow in small groups
4	Grow in large groups
5	Grow in a clump

2.2. Method of determining the coverage of *Eichhornia crassipes* (Mart.) Solms

The river bank length (X) and width (Y) measurement was conducted with a tape measure to determine the coverage of *Eichhornia crassipes* (Mart.) Solms, coming onshore, on the water surface.

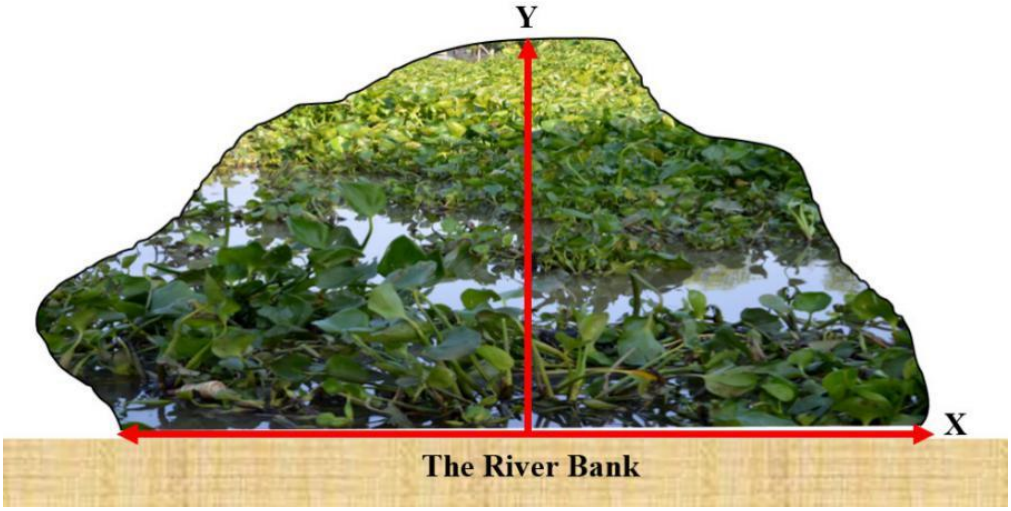

Figure 2. Determination of *Eichhornia crassipes* (Mart.) Solms coverage

III. RESULTS AND DISCUSSION

3.1. *Mimosa pigra* L. (Fabaceae family)

Figure 3. *Mimosa pigra* L.

A: Life form **B:** Leaves **C:** Flower buds **D:** Flowers **E, F:** Fruit **G:** Thorns

Mimosa pigra L. was currently considered as one of the most dangerous weeds for tropical wetlands [6], [7], [8]. So far, most studies have agreed that *Mimosa pigra* L. was the most harmful alien species in Vietnam. This

species has been studied quite intensively in Vietnam [9]. They were distributed in most inland natural and agricultural habitats, freshwater, and coastal areas, and mainly in areas near freshwater [10].

Mimosa pigra L. was an invasive alien woody weed, it has invaded the Mekong River Basin since 1970. It now covers large floodplain areas in fantastical monocultures [11]. This species has been identified as a dangerous weed in the world, including in many countries in Africa [12].

Mimosa pigra L. in the study area:

- In survey area 1: Nhi Binh commune, Hoc Mon district, Ho Chi Minh City, 5 bushes of *Mimosa pigra* L. were recorded, average coverage: West-east = 4 – 5m, North-south = 1.5 – 2m. The average height of the tree was 1.8m. In this zone 1, *Mimosa pigra* L. grew mainly in small groups and large groups (levels 3 – 4).

- In survey area 2: Dong Thanh commune, Hoc Mon district, Ho Chi Minh City, 3 bushes of *Mimosa pigra* L. were recorded, average coverage: West-east = 2.5 – 3m, North-south = 2 – 2.5m. The average height of the tree was 1.0m. In this zone 2, *Mimosa pigra* L. was distributed mainly at levels 1 – 2, including trees of growing alone and growing intobushes .

- In survey area 3: Binh My commune, Cu Chi district, Ho Chi Minh City, 3 bushes of *Mimosa pigra* L. were recorded, average coverage: West-east = 2 – 2.5m, North-south = 1.5 – 2m. The average height of the tree was 1.5m, it was distributed mainly at level 2.

- In survey area 4: Tan Phu Trung commune, Cu Chi district, Ho Chi Minh City, 8 bushes of *Mimosa pigra* L. were recorded, average coverage: West-east = 2.5 – 3.5m, North-south = 2 – 2.5m. The average height of the tree was 2.2m. In this zone 4, *Mimosa pigra* L. was distributed at all levels. This was the region where *Mimosa pigra* L. grew mostly, compared to other survey areas. That caused a significant decrease in the biodiversity of other tree species (decreased in both composition and number of species).

3.2. *Eichhornia crassipes* (Mart.) Solms (Pontederiaceae family)

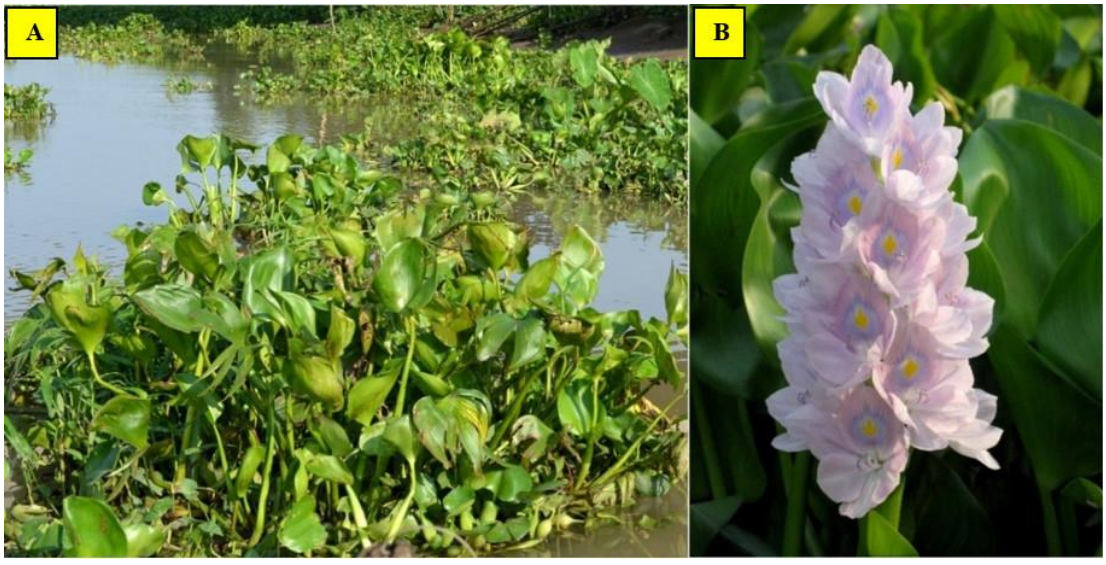

Figure 4. *Eichhornia crassipes* (Mart.) Solms

A: Life form **B:** Inflorescences

In the survey area, *Eichhornia crassipes* (Mart.) Solms grew and reproduced strongly in the rainy season, where *Eichhornia crassipes* (Mart.) Solms formed floating vegetation thick rafts, which obstructed traffic and slowed the flow. Besides, it also hindered aquatic plants and animals from absorbing light, hindered respiration, etc.

When the *Eichhornia crassipes* (Mart.) Solms layers were too thick, they would rot and decay, which polluted water sources and created a very unpleasant odor for an entire area. This pollution caused the death of fish, and all other aquatic resources.

In addition, this dense array of *Eichhornia crassipes* (Mart.) Solms was an ideal habitat for water rats. *Eichhornia crassipes* (Mart.) Solms also prevented the operation of irrigation water pumping stations, causing farmers to spend a lot of effort to keep the system working. This is because it could easily clog the pump, that would cost much money and time to remove *Eichhornia crassipes* (Mart.) Solms.

In the dry season, the average coverage of *Eichhornia crassipes* (Mart.) Solms on the Saigon River was: X ≈ 20 – 25m; Y ≈ 10 – 12m.

In the rainy season, the stronger flow had washed away *Eichhornia crassipes* (Mart.) Solms, limiting them to form rafts, so *Eichhornia crassipes* (Mart.) Solms was not as much as in the dry season: X ≈ 10 – 15m; Y ≈ 5 – 8m.

IV. CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

The spread of alien species into natural communities was threatening native biodiversity, and it was happening at an alarming rate [13].

In this research scope, *Mimosa pigra* L. was detected mainly in small populations. However, there were also some large populations that caused a decrease in biodiversity with only *Mimosa pigra* L. being the dominant species. Therefore, it was necessary to prevent them early in this period before they explode strongly. Ideal solutions would include preventing the entry of the new ones and limiting the spread of the existing ones.

Eichhornia crassipes (Mart.) Solms had many uses, but *Eichhornia crassipes* (Mart.) Solms was an invasive alien species, they grew and thrived in water bodies, especially in the rainy season, causing lots of issues. Therefore, management agencies also need to provide a professional and timely manner to ensure the normal development of aquatic plants and animals, ship , and flow stability.

4.2. Recommendations

The solutions proposed to manage the bioinvasion [14], [15], [16]:

1. Mechanical control:

IAPS will be eliminated by physical means (eg, clearing unwanted things). We just simply uproot or burn and destroy the plant (and seed). In addition, machines and equipments can be used to enhance efficiency.

This method was often preferred over other methods because it had the least impact on non-target species, and did not significantly affect ecosystem stability, but it took more time to achieve the set goals.

2. Chemical control:

This manner uses pesticides, herbicides, poisons, and pharmaceuticals to destroy the IAPS. If the use of these chemicals is not done properly and strictly, the effects of chemicals on non-target species and habitats could become a concern.

3. Biological control:

This method could be used when an IAPS had settled in a new place without being controlled in the wild by parasitic, carnivorous, and disease-causing organisms.

4. Integrated control:

This is a measure that uses many of the above methods to manage invasiveness and prevent the spread of invasive alien species.

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