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Weed Control Management Based on Ecological Monitoring in Huajiang Wildduck Natural Park as an Example

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ABSTRACT

Problems with weed control management include non-compliance with ecological principles, lack of economic efficiency, absence of overall planning, and lack of theoretical basis. This study compiles monitoring results of plant flowering phenology, insects, butterflies, climatic factors, and tourist activities from 2011 to 2024 to serve as the basis for weed control management. From 2011 to 2023, 280 species of vascular plants from 58 families were recorded. The month with the most flowering plant species was April and May. Three rare orchid species: *Spiranthes sinensis*, *Zeuxine strateumatica* and *Eulophia graminea*, were found only in artificial grasslands, with their flowering season between March and April. *Hexacentrus fuscipes* is a rare species, found only in densely growing grassy areas with *Miscanthus floridulus*, *Cenchrus purpureus*, and *Phragmites australis*, and has never been found in artificial or short-grass areas. Butterflies are the best indicator organisms for ecological monitoring. In 2023-24, 1537 butterfly instances of 41 species from 5 families were recorded. The largest number of instances were *Zizeeria maha okinawana* and *Zizina otis riukuensis* (552 instances combined), followed by *Pieris canidia* and *Pieris rapae* (524 instances combined).

Skipper butterfly larvae feed on weedy grasses such as *Miscanthus floridulus* and *Cenchrus purpureus*, so weeding should be avoided during their breeding season. Butterfly numbers are highest in April, and species are most abundant in May; weeding should be avoided during these months. Do not weed during June to August, when average temperatures and rainfall are highest, as ground cover plants protect the ground and soil from erosion and damage caused by heavy rain and high temperatures. The results of this study form the basis for habitat management and can serve as a reference for monitoring climate change, ecological conservation, and environmental education.

Keywords: Huajiang Wildduck Natural Park; Weed Control Management; Ecological Monitoring; Monitoring Volunteers

Introduction

In 2006, a forum at a community café led to the establishment of the Huajiang Wetland Conservation Alliance, a consensus reached among industry, government, and academia. Since January 2008, it has been conducting ecological surveys and monitoring through volunteer-based methods, a practice that continues to this day. The Taipei City Huajiang Wetland Conservation Alliance is a NGO that utilizes volunteers for ecological monitoring. Officially registered in 2014, it has not only established a volunteer-based ecological monitoring model but also pioneered environmental education based on ecological monitoring.

Research Location

With Huajiang Bridge as the boundary, it is divided into north and south regions, and then divided into artificial grassland, short grass region, and long grass region according to the difference of the flora of the north and south regions, for a total of 6 sample stations. Artificial grassland: There are often human activities and regular artificial weeding. The vegetation is more complex, with low herb plants such as gooseberry, water centipede, and nightshade.

Methods

The Taipei Huajiang Wetland Conservation Alliance has been conducting ecological surveys and monitoring since January 2008. These surveys include volunteer-based groups for plants, Moon Pond plants, birds, insects, butterflies, frogs, aquatic invertebrates, and crabs. This ongoing effort demonstrates its commitment to using volunteers for ecological monitoring. Except for the aquatic invertebrate and crab groups, which survey every three months, the plant, Moon Pond plant, bird, butterfly, and frog groups conduct monthly surveys.

Results and Discussion

Plant Floral Phenology

From 2011 to 2024, the plant section recorded 280 species of vascular plants from 58 families, with Poaceae having the most (46 species), followed by Asteraceae (39 species). The month with the most flowering plant species was May for 5 years, April for 5 years, and March, June, and November each for 1 year. The months with the most flowering plant species, April and May, should not be excluded (Figure 1).

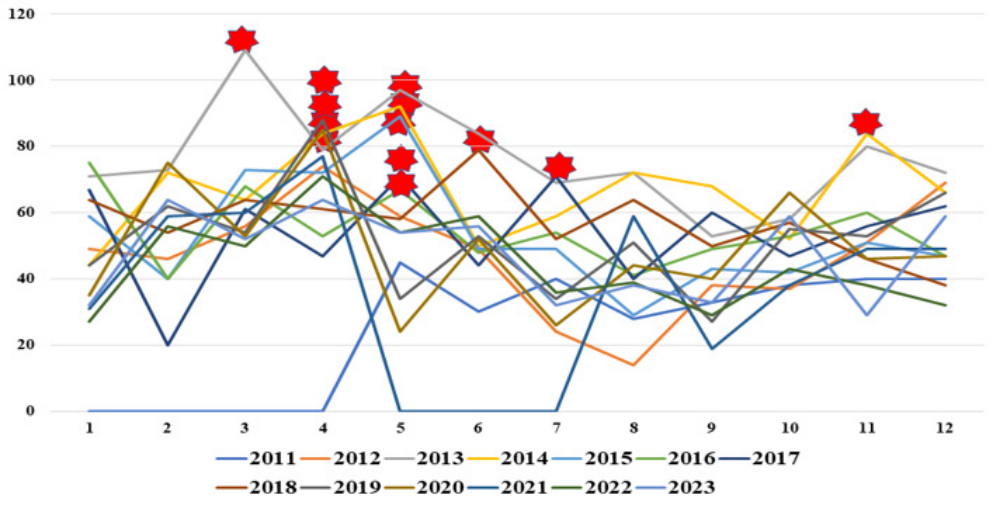

Figure 1: The season with the most flowering species is concentrated in April and May (2011-2023).

Rare and Protected Species

In July 2010, a male *Hexacentrus fuscipes* was discovered. Although it was first published in 1908, it is quite rare and is listed in the list of "species that should have disappeared or are endangered in Taiwan". It is the rarest species found in the Taipei metropolitan area. However, it only appears in dense grassy areas such as *Miscanthus floridulus*, *Cenchrus purpureus*, and *Phragmites australis*. It has never been found in artificial grass areas or short grass areas (Figure 2). There are three rare orchid species recorded: *Spiranthes sinensis*, *Zeuxine strateumatica* and *Eulophia graminea*, which are found only in artificial grasslands and bloom between March and April (Figure 3).

Figure 2: Rare Hexacentrus fuscipes,
A. Male
B. Female.

Figure 3: Three rare orchid:
A. Spiranthes sinensis
B. Eulophia graminea
C. Zeuxine strateumatica.

Butterfly Population Dynamics

Butterfly survey was conducted monthly from 2023 to 25th between Huajiang Bridge and Zhongxing Bridge, using a cross-line survey method. A total of 1537 butterfly individuals from 44 species across 5 families were recorded. The Nymphalidae family had the most species (19), followed by the Skimmer family (7). The most numerous species were *Zizeeria maha okinawana* and *Zizina otis riukuensis* (552 individuals combined), followed by *Pieris canidia* and *Pieris rapae* (524 individuals combined) (Figure 4). The nectar sources for butterflies included 20 species from 11 families, with the Asteraceae family having the most (7 species). All other families had only a single species. The most frequently visited flower species were *Bidens pilosa* var. *radiata* (21 species from 5 families), followed by *Sphagneticola trilobata* (9 species from 4 families). Weeding should be avoided during its flowering season. Butterflies primarily feed on low-growing herbaceous plants, typically less than 20cm tall. However, weeding below 10cm in height can endanger the survival of butterfly larvae on these plants. Skipper larvae feed on grasses considered weeds, such as *Miscanthus floridulus* and *Pennisetum purpureum*, specifically the tender tips of these leaves. During their breeding season, weeding should be avoided. Weeding is also unnecessary during April, when butterfly populations are highest, and May, when the most diverse species appear (Figure 5).

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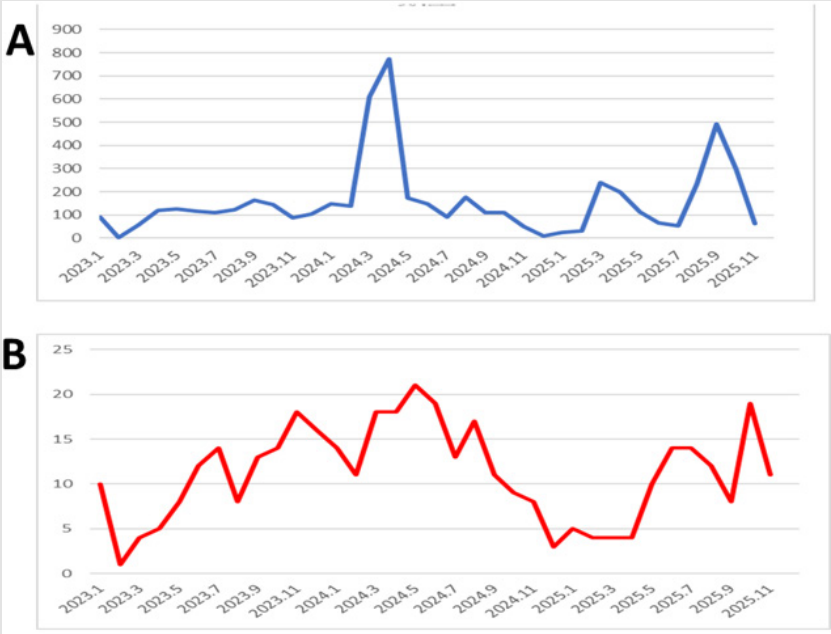

Figure 4: Butterfly changes in Huajiang Wild duck Nature Park:
A. Number
B. Species (2023-2025).

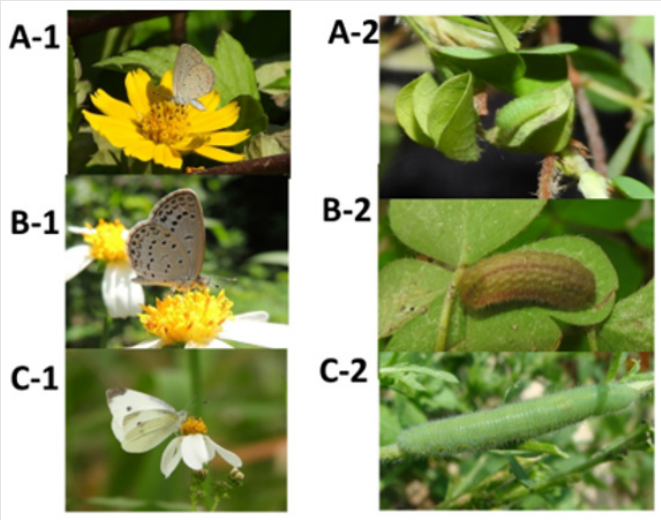

Figure 5: The three most abundant butterfly species in Huajiang Wild duck Nature Park.
1. A-1. Zizina otis riukuensis.
2. A-2. Larva of Zizina otis riukuensis.
3. B-1. Zizeeria maha okinawana.
4. B-2. Larva of Zizeeria maha okinawana.
5. C-1. Pieris rapae.
6. C-2. Larva of Pieris rapae.

Climate Factors

According to data from the Central Weather Administration, weather analysis in northern Taiwan shows that the average annual temperature exceeds 30 degrees Celsius from June to September, with July recording the highest at 34°C, followed by August at 33°C. The average annual rainfall exceeds 400 mm in June and August, with June recording the highest rainfall, followed by August. It is best to avoid weeding during the months with the highest average temperatures and rainfall, as ground cover plants can protect the ground and soil from erosion and damage caused by heavy rain and high temperature (Figure 6).

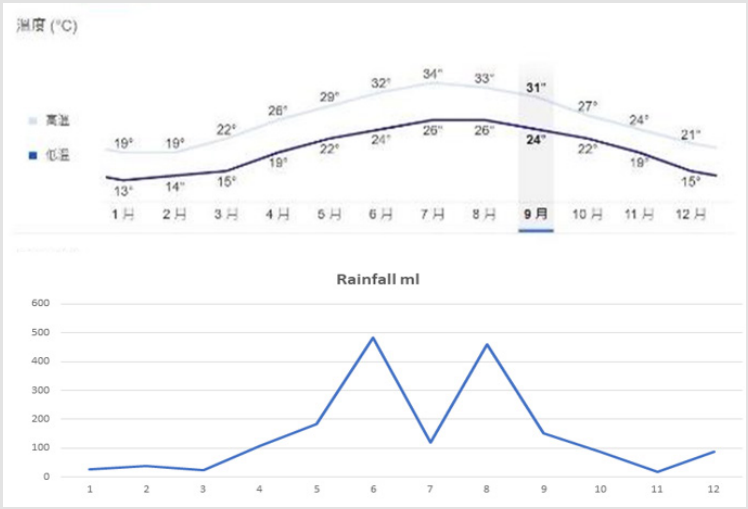

Figure 6: Average temperature and rainfall in northern Taiwan (2025).

Conclusion

Based on the results of the various monitoring studies above, a comprehensive weed control management strategy is proposed, as shown in the Table 1. Although this article uses Taipei's Huajiang Wild duck Natural Park as an example, it aims to serve as a starting point, providing a basis for weed control in all parks, green spaces, national parks, school lawns, botanical gardens, forest recreation areas, and other similar venues, ensuring that weed control is ecological, cost-effective, and environmentally sustainable. The model presented in this article can provide a theoretical foundation for habitat management and serve as a reference for monitoring climate change, ecological conservation, and environmental education [1-5].

Table 1: Weed control management strategies based on various monitoring results.

Key ecological factors	Weed control strategies
Climate factors (Average temperature, Rainfall)	Do not remove from June to August.
Plant floral phenology	Do not remove flowers during April and May when the most flowering varieties are available.
Rare and protected species	Remove the plants in the areas where these three types of orchids are distributed; do not remove them during the orchid flowering season of April and May. Do not remove tall grass in the growing area of *Hexacentrus fuscipes*
Birdwatching factor	Do not remove during the migratory bird season from September to March.
Butterfly conservation	Do not remove host plants for larvae, nectar sources for adults, or during the breeding season.
Tourist safety and activities	Weeding is maintained along trails and in birdwatching areas.

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