

Publisher's note

Using sustainable landscape overwater equipment for improvement of aquatic ecosystem



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ABSTRACT

Green energy, vegetation water purification, and landscape ecological engineering equipment are combined in this study for ecological conservation. The mode field was at the waterside of Taiwan MingDao University. The experimental mode field was about 1.5 m away from the shore, and there were three water tanks with a diameter of 1.7 m and in depth of 2 m. Solar Power Artificial Floating Islands (SAFI) of 60 × 60 cm were placed in the tanks, then tanks with and without SAFI were compared for ecological abundance. The results showed that the sample(s) with SAFI had more than 16 species, and the representative species was the Asian mantis *Hierodula patellifera*. The sample without SAFI merely had 5 species, which were contaminative index species, e.g. larvae of mosquito *Culicidae* and midges *Chironomidae*. We expected this study can be applied to ponds, coasts, lakes, and reservoirs in the future, in order to provide waters with landscaping and environmental conservation facilities.

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1. Introduction

The artificial floating island (AFI), also known as Floating Treatment Wetlands (FTWs), it is another mode of common artificial wetland treatment systems, which emerging plants use for intercommunity (Mallison et al., 2001; Chua et al., 2012). This ecological engineering has been extensively accepted and applied to river weirs, rivers, ponds, and lakes over the world (Ahn et al., 2004). Nakamura and Mueller (2008), Zhu et al. (2011) indicated that the AFI was effective for the reduction of pollution dispersal, wave absorbing revetment, biological conservation, water decontamination and purification, and landscape greening. The emerging plants of AFI are planted on a carrier floating on the water, which can directly absorb nutrient substance from water. Thus, absorption efficiency is higher (Fonder and Headley, 2010; Stewart et al., 2008). Generally, most wetland plants only remove the contaminants from soil media, whereas, the AFI physically removes the suspended solids in water by an underwater plant root system, absorbing the contaminants by biosynthesis, as well as providing biomembrane attachment media (Chang et al., 2012). The AFI root system buffers water waves, removes heavy metals from the water, reduces the light penetration, and competes for nutrients in water, in order to

inhibit the growth of algae (Headley and Tanner, 2006; Zhao et al., 2012). It also provides organisms with habitation and conservation, thus, increasing biological habitats in the waters and providing a safe place for diversified organisms, such as birds, fish, insects, aquatic insects, and gymnophiona. Canada has successfully applied AFI to recover birds (Will and Crawford, 1970; Fager and York, 1975; Payne, 1992; Hiraoka, 1996; Mueller et al., 1996; Momose et al., 1998). Piper et al. (2002) set artificial floating island platforms in 26 lakes. The hatching rate and brooding-success rate of birds on artificial floating island are 69% and 32% more than natural nest. You (2002) and Tien and Wang (2004) indicated that water and environmental pollution levels could be analyzed according to the representative bioindicators in the water area. An AFI was set in New Hampshire Lake of North America in 1900 as the nest and habitat of Gaviidae (AFI Study Group, 2000). The earliest AFI structure in Japan occurred in 1920, where bundled brushwood was placed in a lake to provide egg beds for the reproduction of fish (Hirose, 1997). Such benefits depend on water conditions, the maturity of AFI vegetation, the liveliness of the biomembrane, and other environmental factors, as well as easy relocation and not occupying lands if necessary (John et al., 2009; Wen and Recknagel, 2002). The collected plants can be used to provide economic benefit and create valuable products, such as biogas, biomaterials, food production, fertilizer, and animal feed (Singhal and Rai, 2003; Li et al., 2007). This system is applicable to high temperature and high humidity regions where the temperature never falls to below zero, thus, floating plants

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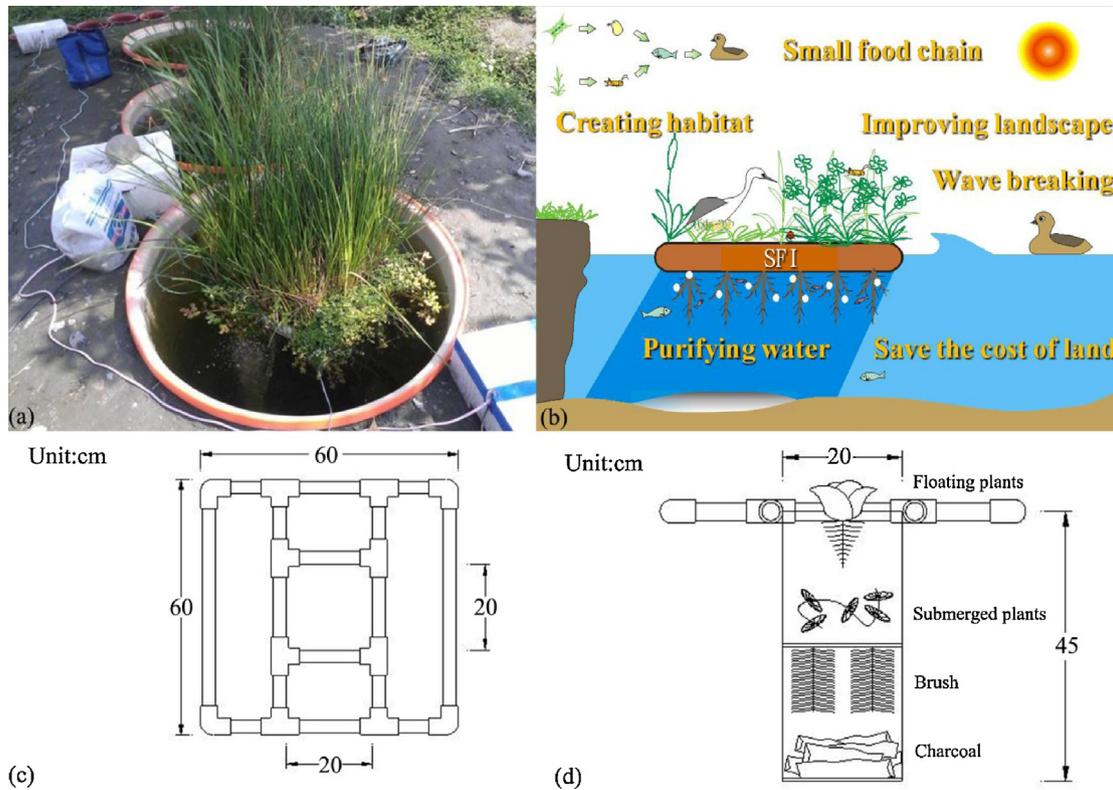


Fig. 1. SAFI structure.

will not die massively during winter, and will continue growing all year around (Chua et al., 2012). In comparison to artificial wetland purification, it saves much land, which is very important for countries with high population density or limited land resources (Zhao et al., 2012).

Nitrogen in wastewater often exists as organonitrogen, ammonia nitrogen, nitrite, nitrate, and nitrogen gas (Korkusuz et al., 2005). When crude sewage flows into free waters, it causes severe water eutrophication, and adverse effects on aquatic ecosystems; whereas, hydrophytes have biological purification effect, thus, the biofiltration of hydrophytes can reduce the nitrogen and phosphorus elements that cause water eutrophication (Li et al., 2007; Bankston et al., 2002; Nahlik and Mitsch, 2006). The hydrophytes absorb nutrient matter from wastewater and substrates for removal (Sheng and Masaaki, 2008). The charcoal is mainly used to reduce toxic organic compounds in water, improve taste, and remove odor (AWWA, 1999).

2. Materials and methods

The experimental site was in MingDao University, Pitou Township, Changhua County, Taiwan, E23°86'79", N120°49'33".

2.1. Materials

2.1.1. SAFI Structure

The size of SAFI is 60 × 60 cm, the opening area of the middle net cage is 20 × 20 cm, the main body of the floating island consists of PVC pipe, coconut fiber mat, black plastic mesh, plastic hose, water plants (submerged, emerging, floating), net cage, solar power supply equipment, and oxygen equipment (Fig. 1). The submerged and floating plants are placed in a net cage, and brushes and charcoal are added as the water filtering media. There is 1 kg strip of charcoal and four brushes. The brushes hang in the net cage; the charcoal

strips are staggered on the cage bottom for water to flow through, and the power panel supplies power to the oxygen equipment at three points around the floating island. The silica gel hose extends downwards to 5 cm above the bottom, and an air stone is connected for aeration, which creates a high oxygen environment to increase the water purification efficiency of internal microorganisms. The plants are mixed at intervals of 10 cm outwards from the net cage at the center, and the plants are planted in descending order of height (Fig. 2).

Sample(s) A is from the Li-tze Lake; SB is from the discharge point of sewage from the university dormitory; and SC is discharge point from the WWTP of university. SD, SE and SF represent different tanks with and without Solar Powered Artificial Floating Islands. SD is an aerated tank equipped with a SAFI and filled with water

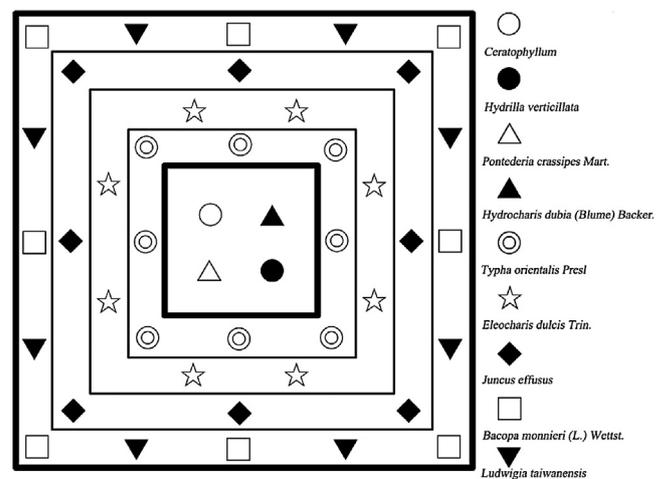


Fig. 2. Aquatic plants configuration.

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