Survey data of diatoms on seawater artificial floating islands

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Abstract

This dataset recorded benthic diatoms attached to the diatom boards installed on the artificial floating islands (AFIs) in the seawater in Anping Historical Waterview Park, Tainan, Taiwan. Diatoms were cultured using diatom boards and sampled four times from October to December, 2017. A total of 45 diatom species belonging to 22 genera were identified. Among them, the *Navicula* genus was the highest in richness, and *Achnanthes subsessilis* and *Nitzschia longissima* dominated in number.

Key words: Artificial Floating Island, diatoms, sampling event

海水人工浮島矽藻調查資料

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摘要

本資料集提供2017年10月至12月於台南市安平歷史水景公園人工浮島上進行附生矽藻培養，並進行 4 次採集與藻種鑑定所得結果，於附著藻板之矽藻共鑑定出 22 屬 45 種，其中以菱形藻屬 (*Navicula*) 種類最多，*Achnanthes subsessilis* 及 *Nitzschia longissima* 爲數量優勢藻種。

關鍵詞：人工浮島、矽藻、取樣事件

Introduction

An artificial floating island (AFI) is a group of plants cultivated on artificial platforms that float on water. AFIs are typically established for various objectives such as bank erosion prevention and shoreline protection, landscape design and planning, wildlife habitat provision, and water purification and filtration (Hoeger 1988; Nakamura and Mueller 2008). Studies on the water purification and filtration function of AFIs have focused on the effects of nutrient absorption of vascular plants and the wildlife habitat provided by AFIs (Stewart *et al.* 2008; Billore 2009; Li *et al.* 2010; Zhang *et al.* 2014). However, few studies have addressed the structure of AFIs or the microorganisms attached to the underwater root systems. Diatoms constitute the main species in water bodies, and they provide a food source for primary producers and other organisms in the underwater biosphere. Additionally, the structure and plant root systems of AFIs provide surfaces for the effective attachment of diatom substrates (Nakamura *et al.* 1995). To address the research gap regarding benthic diatoms on AFIs, this study investigated benthic diatoms on AFIs established on seawater. The diatom species and related environmental data collected and established by this study can serve as reference for future investigations.

Methods and Materials

1. Sampling Location

The Anping Historical Waterview Park in Tainan, Taiwan, (120˚15'21.81" E, 22˚00'00.84" N) served as the sampling location for this study (Fig. 1). The park has a water area of approximately 6 km² and water depth of 3 m. The southern portion of the park is connected to the Anping harbor area and the Tainan Canal; the northern portion comprises the Yanshui River basin and estuary. The gauge height within the park varies with the sea tide; the water salinity level is generally between 31 and 35 ppt (Lin 2017). Since 2016, seven AFIs have been established by faculty members and students of the Department of Hydraulic and Ocean Engineering of National Cheng Kung University. The established AFIs comprise plants such as *Sesuvium portulacastrum* (L.) L. and *Avicennia marina* (Forsk.) Vierh (Fig. 2). This study conducted culture, sampling, investigation, and identification processes on three of these AFIs to obtain information regarding benthic diatoms.

According to 2017 data obtained from the Tainan Anping Observation Station of the Central Weather Bureau (Table 1), the annual rainfall amount in Anping is 1,055 mm and the mean annual temperature is 25.4˚C. To prevent the effects of typhoon or intense rainfall during summer, diatom boards were installed in October. The mean monthly temperatures during the investigation period were 27.4˚C (October) and 24˚C (November), and the rainfall measurements were 42 (October) and 3.5 (November) mm. An on-site test of the park's water quality conducted on October 28, 2017, revealed that the water pH was 8.28, water temperature was 26.5˚C, salinity was 34 ppt, dissolved oxygen concentration was 7.87 mg/L, and turbidity was 1.23 FNU (Formazin Nephelometric Units). Therefore, the water had a high dissolved oxygen concentration as well as high transparency.

Fig. 1. Sampling location.

Fig. 2. AFIs established by faculty members and students of the Department of Hydraulic and Ocean Engineering of National Cheng Kung University.

Table 1. Meteorological data recorded in 2017 in the Anping Historical Waterview Park (Anping Observation Station of the Central Weather Bureau)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Ambient Temperature (˚C)	19.7	18.9	21.9	5	28.1	29.7	30	30.1	30.2	27.3	24	19.3	25.4
Rainfall (mm)	0	0.5	11	63	71	217.5	438	175	33	42	3.5	0.5	1055

2. Diatom Sampling

This study includes a total of five sampling events, which is defined by the date the samples were retrieved from the field. Of the five events, four were sampling of benthic diatoms, which is gathered from the field on October 23, October 31, November 20, and November 30, 2017. The fifth is a sample of planktonic diatoms, which is sampled from the field on October 28, 2017 with a test on the park's water quality. Further details of the sampling process are given below.

(1) **Culture of benthic diatoms:**

Eight diatom boards (transparent acrylic boards measuring 15×15 cm^2) were placed on each of the three AFIs on October 16, 2017. Subsequently, sampling processes were conducted on October 23, October 31, November 20, and November 30, 2017, with the culture period being 7, 15, 35, and 45 days, respectively.

(2) **Sampling of benthic diatoms:**

On each sampling date, two of the diatom boards were removed from the AFIs; specifically, a total of six boards were retrieved on each sampling session. The retrieved boards were covered with tin-foil paper for shading, after which they were sent to the laboratory under refrigeration. The benthic diatoms were then scraped off using toothbrushes.

(3) **Sampling of planktonic diatoms:**

For comparison with the benthic diatoms, this study sampled the water near the Historical Waterview Park regions in which the diatom boards were placed on October 28. The collected water samples were subjected to centrifugation, acid washing, and fixation in the laboratory. Subsequently, observation and identification processes were conducted on the water samples.

(4) **Identification of diatoms:**

All the diatom fluids were first concentrated in a centrifugal machine for 10 minutes at 3,500 rpm; the fresh diatoms were then observed using a differential interference contrast microscope (OLYMPUS, BX51; 1,000X). Subsequently, acid washing was conducted using concentrated sulfuric acid, after which observation and identification processes were performed using an electron microscope (HITACHI, TM 3000; 4,000–10,000X). The main reference items for identification were *The Diatoms: Biology and Morphology of the Genera* (Round *et al.* 1996) and *Freshwater Diatom Flora of Taiwan* (Wu *et al.* 2011).

Results

1. Diatom board fouling

During the 45 days of culture of benthic diatoms, the diatom boards were retrieved on days 7, 15, 35, and 45 and sent to the laboratory, where the benthic diatoms were then scraped off. Figure 3 presents the changes observed on the diatom boards. The organisms found on the diatom boards varied with time. On day 7 (Fig. 3a), benthic diatoms, cyanobacteria, and other algae were observed, but the coverage was not extensive. On day 15 (Fig. 3b), the diatom boards were completely covered by various algae including *Ulva fasciata*, a type of macroalgae of the *Ulva* genus; some fouling marine organisms such as Balanidae and Sabellidae of Sabellida were also observed. On day 35 (Fig. 3c), the diatom boards were fully covered by macroalgae and fouling organisms. Finally, on day 45 (Fig. 3d), the diatom boards were mostly covered by Balanidae, whereas only a few green algae and Sabellidae were observed.

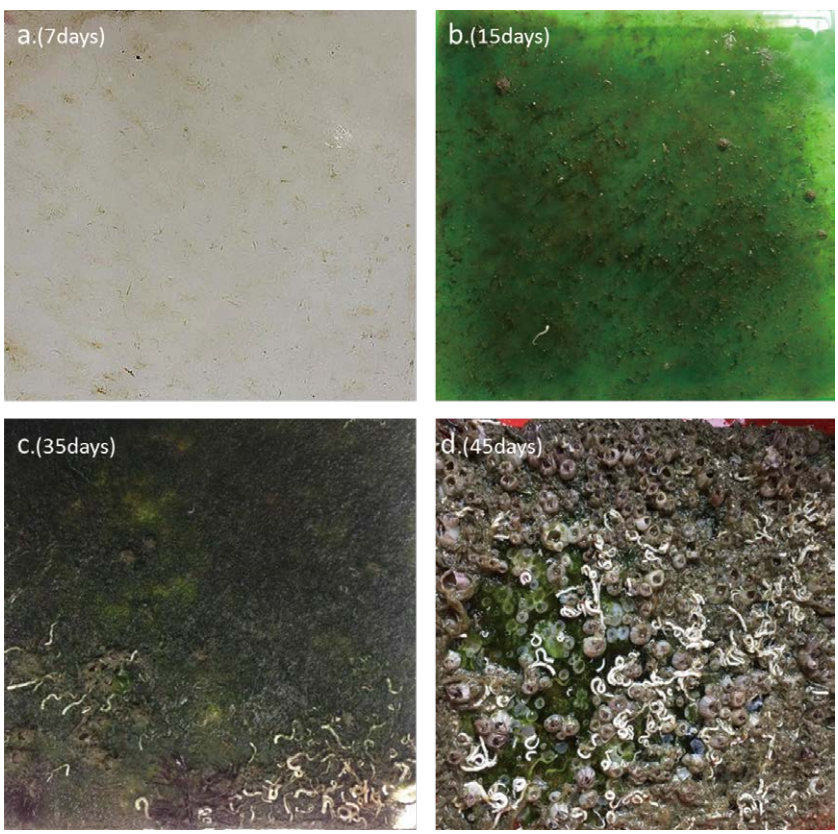

Fig. 3. Changes observed on diatom boards during different culture stages.

2. Diatom species

Among the fouling diatoms on the diatom boards and the planktonic diatoms in the water, a total of 46 diatom species belonging to 23 genera were identified after acid washing. Of the identified species, 45 were observed on the diatom boards and 24 were observed in the water. The majority of the diatoms identified belonged to *Navicula*; they were six in total and included *Achnanthes subsessilis* and *Nitzschia longissima*, which were the dominant species in number. In addition, *Haslea spicula*, *Plagiotropis lepidoptera*, and *Thalassiosira tealata* were observed on the diatom board, indicating the preceding three species belong to phytoplankton.

Table 2 lists the diatoms documented in this study. A database containing the morphological pictures of all listed diatoms and relevant environmental data was established. This database can serve as a reference for related future research.

Datasets

Dataset description

Object name: Darwin Core Archive The_Survey_Data_of_Benthic_Diatoms_in_Anping_Historical_Waterview_Park

Character encoding: UTF-8

Format name: Darwin Core Archive format

Format version: 1.0

Distribution: http://ipt.taibif.tw/archive.do?r=the_survey_data_of_benthic_diatoms_in_anping_historical_waterview_park

https://www.gbif.org/dataset/a0998d3b-4a7f-4add-8044-299092d9c63f

https://doi.org/10.15468/mwzwls

Publication date of data: 2018-08-31

Language: Chinese

Table 2. Diatoms recorded in Anping Historical Waterview Park

Families	Genera	Species	Niche types	
			Periphytic	Planktonic
Achnanthaceae	*Achnanthes*			
		Achnanthes brevipes C.Agardh	v	v
		Achnanthes kuwaitensis Hendey	v	v
		Achnanthes subsessilis Kützing	v	v
Achnanthidiaceae	*Achnanthidium*			
		Achnanthidium sp.	v	
Achnanthidiaceae	*Planothidium*			
		*Planothidium septentrionalis (Ø*strup*)* Round *&* Bukhtiyarova	v	
Bacillariaceae	*Nitzschia*			
		Nitzschia acicularis (Kützing) W.Smith	v	
		Nitzschia frustulum (Kützing) Grunow	v	
		Nitzschia inconspicua Grunow	v	
		Nitzschia longissima (Brébisson) Ralfs	v	v
		Nitzschia microcephala Grunow	v	v
		Nitzschia sigma (Küetz.)W.Smith	v	v
Bacillariaceae	*Psammodictyon*			
		Psammodictyon constrictum (W.Gregory) D.G.Mann	v	
		Psammodictyon panduriforme (W.Gregory) D.G.Mann	v	v
Biddulphiaceae	*Biddulphia*			
		Biddulphia longicruris Greville	v	
		Biddulphia reticulata Roper	v	
Catenulaceae	*Amphora*			
		Amphora biggiba Grunow	v	

Table 2. Diatoms recorded in Anping Historical Waterview Park (cont. I)

Families	Genera	Species	Niche types	
			Periphytic	Planktonic
		Amphora coffeaeformis (C.Agardh) Kützing	v	v
		Amphora sublaevis Hustedt	v	v
Cocconeidaceae	*Cocconeis*			
		Cocconeis pellucida Hantzsch	v	v
		Cocconeis placentula Ehrenberg	v	v
		Cocconeis scutellum var. scutellum Ehrenberg	v	v
Cymatosiraceae	*Campylosira*			
		Campylosira cymbelliformis (A.W.F.Schmidt) Grunow ex Van Heurck	v	
Diploneidaceae	*Diploneis*			
		Diploneis oblongella (Nägeli ex Kützing) Cleve-Euler	v	v
Gomphonemataceae	*Encyonema*			
		Encyonema minutum (Hilse) D.G.Mann	v	
Licmophoraceae	*Licomophora*			
		Licomophora ehrenbergii var. *ovata* (W.Smith) Van *Heurck*	v	
Naviculaceae	*Gyrosigma*			
		Gyrosigma tenuissimum (W.Smith) J.W.Griffith & Henfrey	v	
Naviculaceae	*Haslea*			
		Haslea nautican (Cholnoky) *Giffen*	v	
		Haslea spicula (Hickie) Bukhtiyarova		v
Naviculaceae	*Navicula*			
		Navicula gottlandica Grunow in Van Heurck	v	v
		Navicula perminuta Grunow	v	

Table 2. Diatoms recorded in Anping Historical Waterview Park (cont. II)

Families	Genera	Species	Niche types	
			Periphytic	Planktonic
		Navicula sp.1	v	v
		Navicula torneensis Cleve	v	
		Navicula tripunctata (O.F.Müller) Bory	v	
		Navicula symmetrica R.M.Patrick	v	
Naviculaceae	*Seminavis*			
		Seminavis strigosa (Hustedt) Danieledis & Economou-Amilli	v	v
Plagiotropidaceae	*Plagiotropis*			
		Plagiotropis lepidoptera (W.Gregory) Kuntze		v
Pleurosigmataceae	*Pleurosigma*			
		Pleurosigma finmarchicum Grunow	v	
		Pleurosigma intermedium W.Smith	v	
Rhoicospheniaceae	*Gomphonemopsis*			
		Gomphonemopsis pseudexigua (R.Simonsen) Medlin	v	
Skeletonemataceae	*Skeletonema*			
		Skeletonema tropicum Cleve	v	v
Stephanodiscaceae	*Cyclotella*			
		Cyclotella meneghiniana Kützing	v	v
Thalassiosiraceae	*Thalassiosira*			
		Thalassiosira minima Gaarder	v	v
		Thalassiosira minuscula Krasske	v	
		Thalassiosira tenera Proschkina-Lavrenko		v
		Thalassiosira tealata Takano	v	v

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