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Study on Suitability of Artificially Planted Native Mangroves in Coastal Areas of Guangzhou

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Abstract: At present, the mangrove species planted in the coastal area of Guangzhou is relatively single, and the dominant species is mainly the non-petal *Sonneratia caseolaris* (alien species). From 2020 to 2021, after the observation of the growth of mangroves on the north shoreline of the Humen Bridge (Guangzhou Section) in Nansha District, Guangzhou, it is shown that the dominant local mangrove species suitable for growth in the coastal area of Guangzhou are *Kandelia obovata* and *Aegiceras corniculatum*.

Keywords: Mangroves; Guangzhou; Native species; Suitability

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1. Introduction

After collecting data [1-3] and on-site investigation, there are 12 families, 15 genera and 17 species of mangroves in the coastal area of Guangzhou, including 8 families, 9 genera and 10 species of true mangroves, and 6 families of semi-mangroves. There are 7 genera and 7 species, and there are 16 main mangrove communities. At present, the species of mangroves under artificial cultivation are relatively single, the dominant species are mainly non-petal *Sonneratia caseolaris* (alien species), and the local dominant species are *Aegiceras corniculatum*, *Kandelia obovata* or sea hibiscus.

2. Research methods

2.1. Basic situation

In 2020, a key bay renovation project will be carried out on the north coastline of the Humen Bridge (Guangzhou Section) in Nansha District, Guangzhou City, with a 955 meters long coastline, of which 0.49 hectares of locally grown mangroves and about 4,300 surviving mangrove trees are planted [4]. At the beginning of the design of the restoration plan, the local mangrove "*Aegiceras corniculatum* + *Avicennia marina* + *Kandelia obovata*" combination community was selected according to the results of a field survey and comprehensive consideration of the shoreline restoration site.

2.2. Tracking and monitoring methods

The mangrove planting time in this study area was October 2020. From November 2020 to November 2021, a total of four tracking and monitoring of mangrove growth were carried out using the sampling method. One fixed quadrat (10 × 10 m^2) was set for each mangrove community, all planted mangrove seedlings were numbered in each fixed plot. A measuring tape and vernier caliper was used to accurately measure and record the height, crown area, ground diameter, and height of each plant. 10 plants were randomly

selected in each plot, and the photosynthetic efficiency of the plants was detected by a portable chlorophyll fluorescence meter [5,6]. The monitoring times were the beginning of November 2020, the end of December 2020, the end of May 2021, and the end of September 2021.

3. Monitoring analysis

3.1. Morphological monitoring and analysis

3.1.1. *Kandelia obovata* community

In the first monitoring, all the plants in the plot were numbered and listed, and there were 60 *Kandelia obovata* in total. The second monitoring found that the number of plants did not change. All plants survived and most of them grew well. The survival rate was 100%, which means that the plants could well adapt to the natural environment in the region. In the third monitoring, after the dry season from December to April, the number of plants decreased by 13, but the surviving plants were still growing well. The fourth monitoring showed that the average ground diameter and average crown area increased significantly after the vigorous growth period from 5 to 19 months. The management and protection units replanted after the third monitoring, so the number of plants in the community increased, and the average crown area did not increase significantly after replanting. (**Figures 1 and 2, Table 1, and Figure 3)**

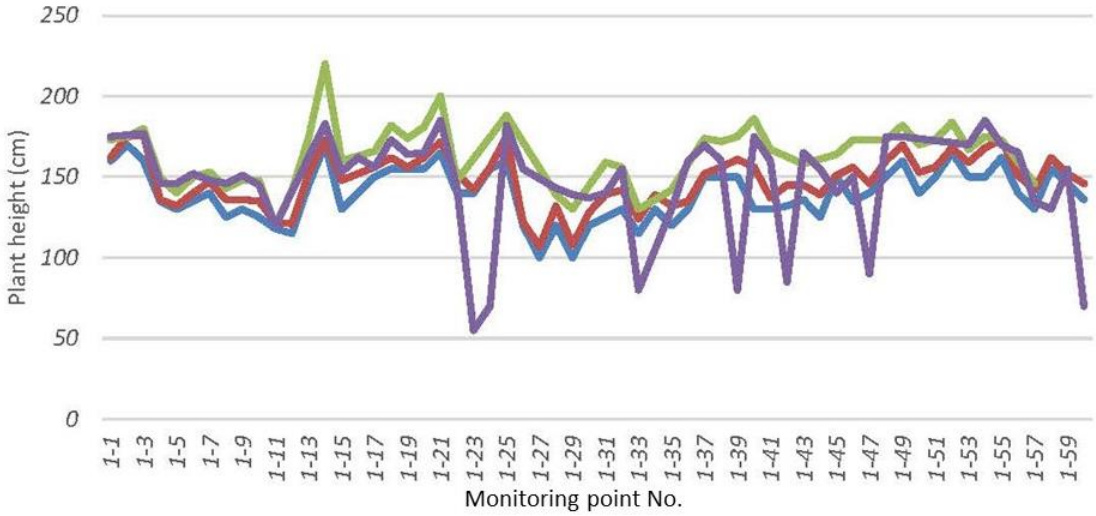

Figure 1. Height comparison of *Kandelia obovata* plants (Notes: blue line represents the first monitoring, brown line represents the second monitoring, green line represents the third monitoring, and purple line represents the fourth monitoring)

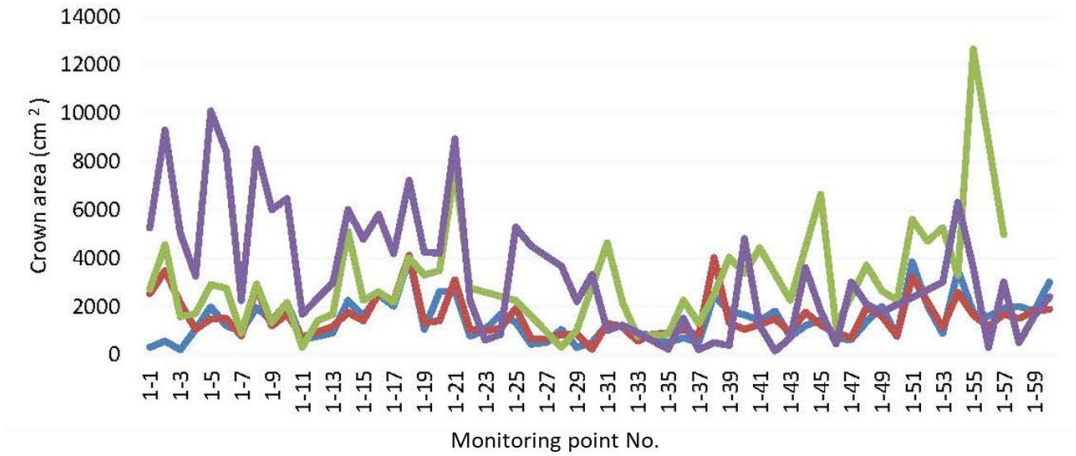

Figure 2. Comparison of crown area of *Kandelia obovata* (Notes: blue line represents the first monitoring, brown line represents the second monitoring, green line represents the third monitoring, and purple line represents the fourth monitoring)

Table 1. Comparison table of the average data of four monitoring times of *Kandelia obovata*

Session/Content	Quantity	Average height (cm)	Average ground diameter (mm)	Average crown area (cm ^{2})	Survival rate (%)
1	60	140	28	1596	100.0%
2	60	148	33	1528	100.0%
3	47	161	34	3086	78.3%
4	55	146	40	3443	91.7%

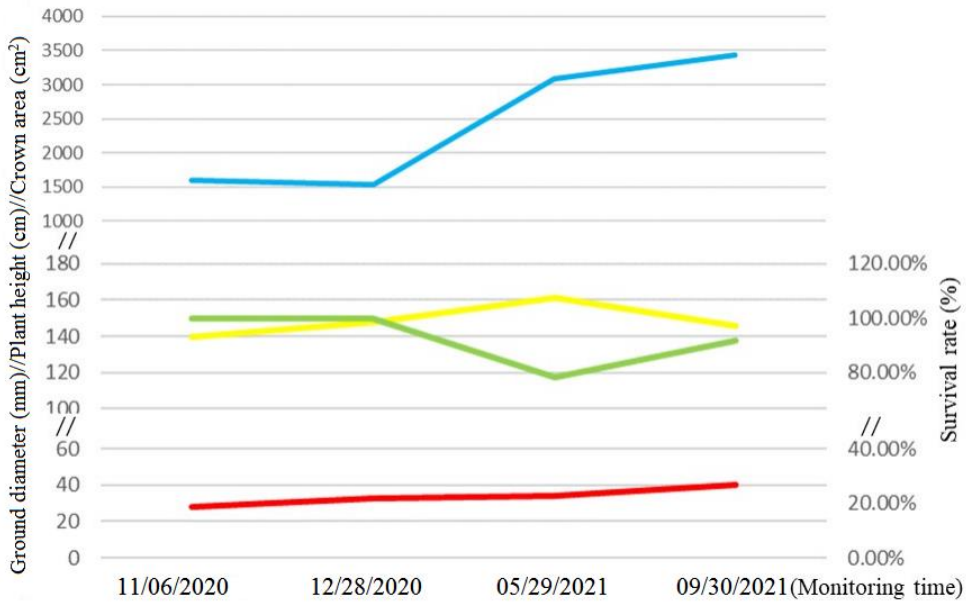

Figure 3. Average data of four monitoring times of *Kandelia obovata* (Note: yellow line represents height [cm], red line represents ground diameter [mm], blue line represents crown area [cm^2], green line represents survial rate [%])

3.1.2. *Aegiceras corniculatum*

During the first monitoring, there were a total of 70 plants in the plot. There was no change in the number of plants in the second monitoring, and all the plants survived and grew well, indicating that the *Aegiceras corniculatum* seedlings can well adapt to the environment in this area. In the third monitoring, after a dry season, the number of plants decreased by 11, but the growth of the surviving plants was still very good, indicating that they had a strong ability to adapt to the environment in this area. At the fourth monitoring, a period of vigorous growth could be seen compared to the results of the previous three monitoring, the average ground diameter and average crown area increased significantly, and the number of plants remained unchanged, indicating that the community was in a relatively stable state, and is showing good growth. (**Figure 4, Figure 5, Table 2 and Figure 6**)

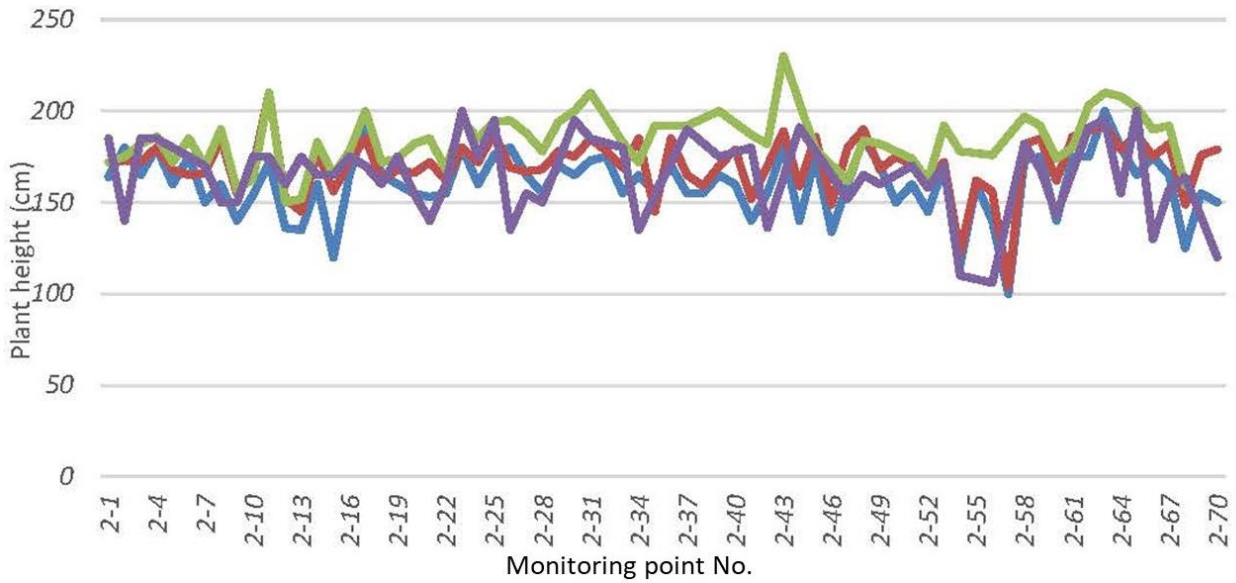

Figure 4. Comparison of heights of *Aegiceras corniculatum* plants (Notes: blue line represents the first monitoring, brown line represents the second monitoring, green line represents the third monitoring, and purple line represents the fourth monitoring)

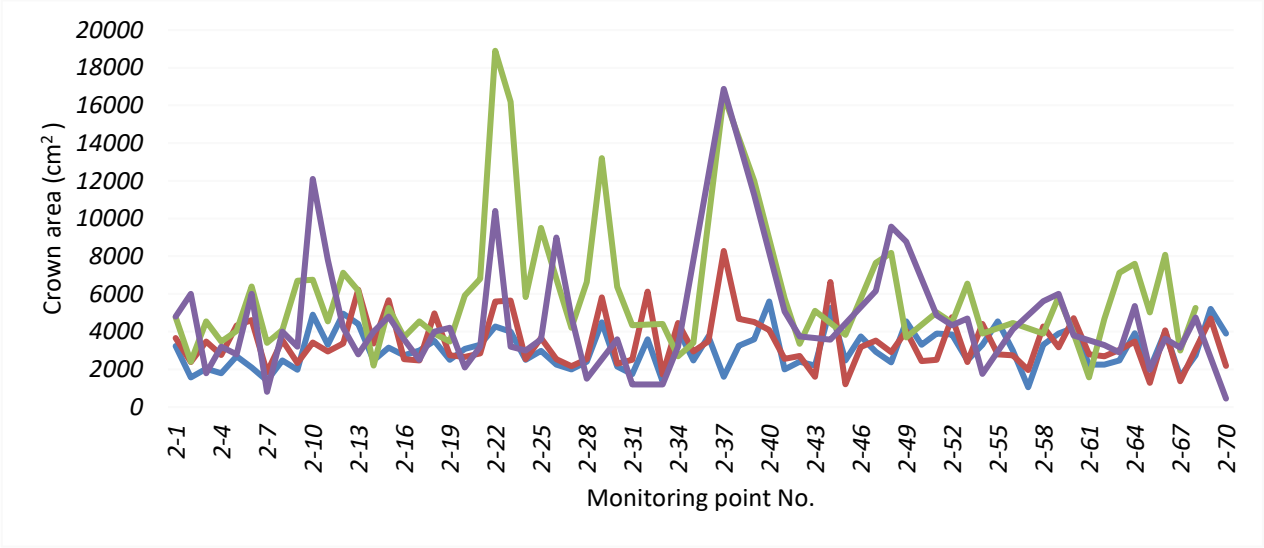

Figure 5. Comparison of crown areas of *Aegiceras corniculatum* (Notes: blue line represents the first monitoring, brown line represents the second monitoring, green line represents the third monitoring, and purple line represents the fourth monitoring)

Table 2. The average data comparison table of the four monitoring of *Aegiceras corniculatum*

Session/ Content	Quantity	Average height (cm)	Average ground diameter (mm)	Average crown area (cm^2)	Survival rate (%)
1	70	160	30	3055	100.0%
2	70	170	30	3442	100.0%
3	59	184	35	5903	84.3%
4	59	165	43	4601	84.3%

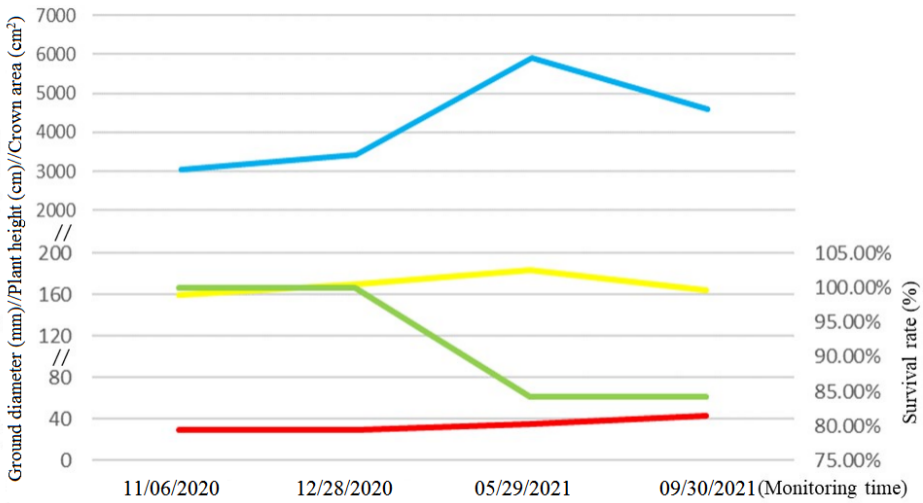

Figure 6. Average data of four monitoring times of *Aegiceras corniculatum* (Note: yellow line represents height [cm], red line represents ground diameter [mm], blue line represents crown area [cm^2], green line represents survial rate [%])

3.1.3. *Avicennia marina* community

In the first monitoring, a total of 123 *Avicennia marina* were planted in the plots. The second monitoring found that the species of plants in the community changed greatly. Some *Kandelia obovata* and *Aegiceras corniculatum* were planted in the plot. The number of plants could not be recovered either. After renumbering, a total of 141 plants were measured. During the third monitoring, the plant species in the plot were still *Avicennia marina*, *Kandelia obovata* and *Aegiceras corniculatum*. Compared to the second monitoring, the position of the plants changed, and some plants died and disappeared, and the plant numbers could not be completely restored. The overall survival rate of the plots was 79%. In the fourth monitoring, the average ground diameter increased significantly, but the survival rate decreased to 70%. The plot was located in an area with severe tidal erosion, the surface backfill was mostly washed away, and the root system was more exposed, so the survival rate is low, and from the comparison of ground diameter and crown area, the growth condition of *Avicennia marina* community is average, which is suitable for the local environment. Due to repeated replanting in this sample area, plant height and crown area are no longer compared separately. (**Table 3** and **Figure 7**)

Table 3. Comparison of the average data of four times of monitoring of *Avicennia marina*

Session/Content	Quantity	Average height (cm)	Average ground diameter (mm)	Average crown area (cm^2)	Survival rate (%)
1	123	108	21	563	100.0%
2	141	115	16	1324	114.6%
3	111	112	21	2512	78.7%
4	99	103	29	1954	70.2%

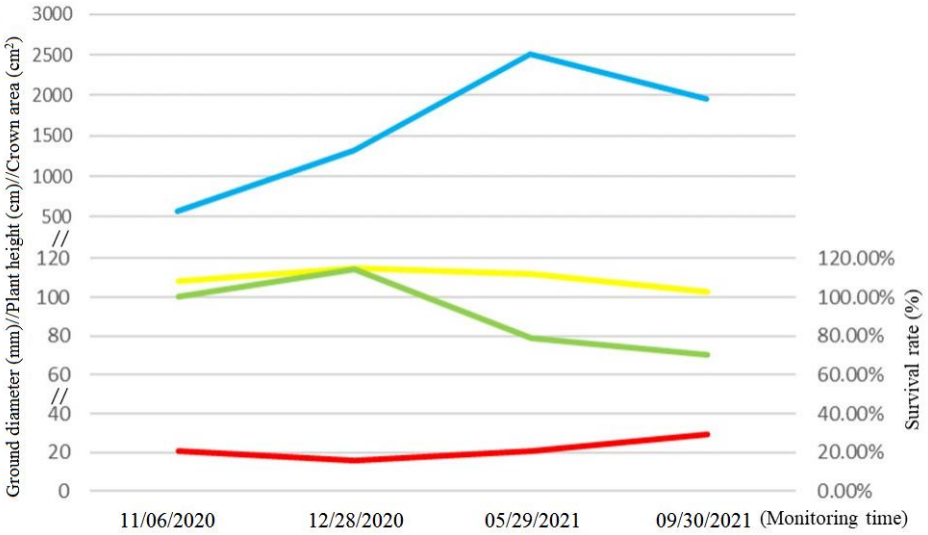

Figure 7. Comparison of the average data of four times of monitoring *of Avicennia marina* (Note: yellow line represents height [cm], red line represents ground diameter [mm], blue line represents crown area [cm^2], green line represents survial rate [%])

3.2. Chlorophyll fluorometer monitoring data analysis

In order to detect the photosynthetic activity of mangrove seedlings, 10 randomly selected plants in each plot were scanned by a portable chlorophyll fluorescence meter. From the monitoring data, the levels of photosynthesis of the three mangrove communities are still generally low, indicating that plants are still subject to greater environmental stress or human disturbance. During the first monitoring, the plants of each community had just been planted, and the plants were in the slow seedling stage. The levels of photosynthesis of the second monitoring is generally lower than the value of the first, which may be related to the low temperature in winter during the measurement. The levels of the third monitoring, which was in May increased significantly, indicating that the growth state of the plants significantly improved compared to the previous two monitoring, indicating that the plants were in a period of vigorous growth. Compared with the third time, the value of the fourth monitoring has a small increase, and the overall photosynthesis level is high. (**Figure 8**, **Figure 9**, and **Figure 10**)

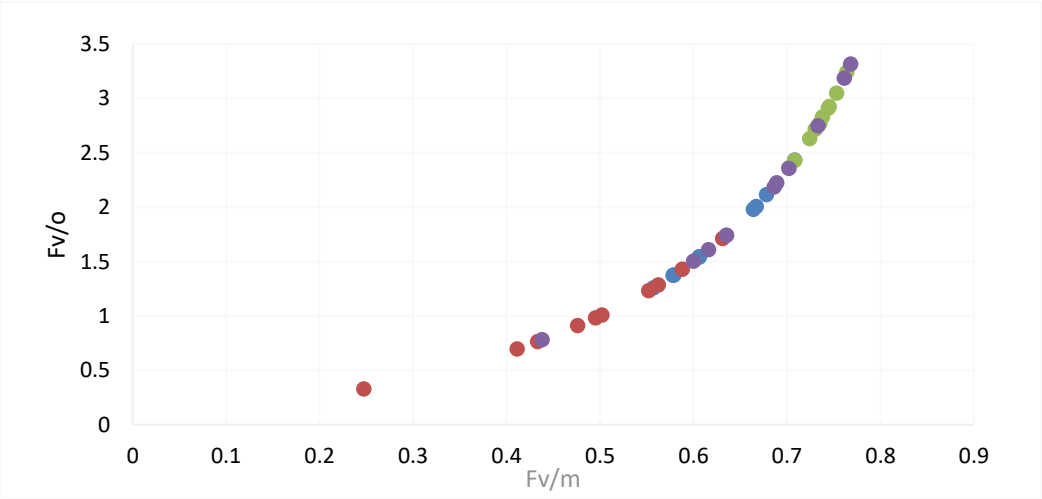

Figure 8. Chlorophyll fluorescence meter monitoring data of *Kandelia obovata* (Notes: blue spot represents the first monitoring, brown spot represents the second monitoring, green spot represents the third monitoring, and purple spot represents the fourth monitoring)

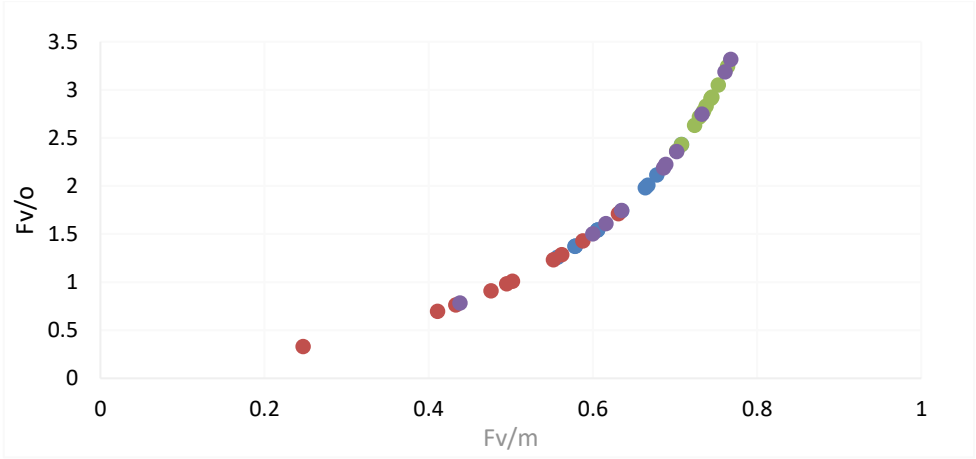

Figure 9. Chlorophyll fluorescence meter monitoring data of *Aegiceras corniculatum* (Notes: blue spot represents the first monitoring, brown spot represents the second monitoring, green spot represents the third monitoring, and purple spot represents the fourth monitoring)

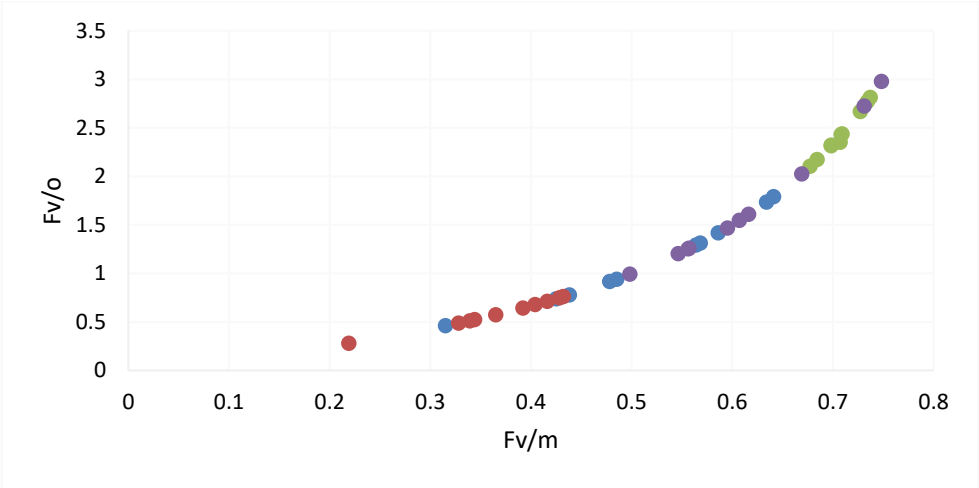

Figure 10. Chlorophyll fluorescence meter monitoring data of *Avicennia marina* (Notes: blue spot represents the first monitoring, brown spot represents the second monitoring, green spot represents the third monitoring, and purple spot represents the fourth monitoring)

4. Conclusions and recommendations

4.1. Conclusion

(1) According to the growth monitoring of the three communities in the study area, the *Kandelia obovata*, the *Aegiceras corniculatum* and the *Avicennia marina*, one year after artificial planting, it can be found that the overall growth state of the *Kandelia obovata* and the *Aegiceras corniculatum* is good, and the growth environment of the region affects the growth of the plants. The adaptability is good, and the growth state of the *Aegiceras corniculatum* community is continuous and more stable.

(2) This study area is one of the demonstration bases for artificial planting of native mangroves in the coastline ecological restoration project, which is managed by a professional maintenance team in order to ensure the effect of coastline ecological restoration. The overall survival rate has decreased after the third monitoring is completed. Afterwards, each colony was replanted. The average height and average crown width basically decreased in varying degrees. But from the overall view of various monitoring data, it does not affect the basic judgment of "the adaptability of *Kandelia obovata* and *Aegiceras corniculatum* to the growth environment in this region" [7,8].

4.2. Recommendations

(1) There are few silty coastlines in the coastal zone of Guangzhou. It is recommended to carry out mangrove conservation and restoration work in suitable areas in estuaries and shoals to achieve the purpose of promoting silt deposition, improving estuary water quality, and expanding the habitat of marine fish and birds [9].

(2) The territorial government should strengthen the management and protection of mangroves, intensify man-made restoration and protection in the sparsely growing mangrove areas, and establish a mangrove reserve within the area [10].

(3) Strengthen the continuous monitoring of alien invasive species, take timely measures to eradicate the spread of alien invasive species, and closely monitor the planted *Sonneratia caseolaris* forest [11].

Disclosure statement

The author declares no conflict of interest.

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