Developmental Trajectory of the American Yacht Clubs: Using Temporal-Spatial Analysis and Regression Model

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ABSTRACT

The yacht industry is one of the leading industries used to guide residents’ increase in consumption. This study analyzes the evolving spatial pattern of yacht clubs in the United States from 1900-2017, aiming to explore the developmental trajectory of yacht clubs in the United States. This study finds that: 1) Yacht clubs in the United States clustered aggregately and unevenly. The concentration of yacht clubs ranges from the northeastern part of the United States to the western and southern regions. 2) The driving factors influencing the development of yacht clubs in the United States changed along with time. The state ship and boat building industry was the main driving factor in Phase I (before 1900). The state steel industry was the main driver in Phase II (1900-1950). In Phase III (1950-2000), state tourism GDP became the main driver, and in Phase IV (2000-2017), state GDP and state ocean tourism and recreation GDP became the main factors. This study enriches the literature in the area of yacht tourism in terms of understanding the temporal-spatial pattern of yacht clubs.

KEYWORDS

Arc GIS, Driving Factors, Temporal-Spatial Pattern, Yacht Clubs

INTRODUCTION

The yacht industry is a collection of high-value-added industries, which not only guides residents to upgrade their consumption (Chen & Shu, 2013), but also boosts the regional economy by means of yacht manufacturing, marina construction, yacht maintenance and construction of tourism supporting facilities (Cheng et al., 2013; Wang, 1999). Based on the data from the International Council of Marine Industry Associations (ICOMIA), yacht sales reached $40 billion (USD) in 2018, and the related maintenance industry yielded an even greater $50 billion worldwide (ICOMIA, 2019). In particular, yacht consumption has been always at the core position of the yacht industry. Sales of yachts are prevalent in developed countries. On average, the number of yachts per capita has reached about 30 people/yacht, and the proportion is even as high as 15 people/yacht in certain developed countries (Cruise & Yacht Branch of China Transportation Association, 2017). In academia, yacht tourism is the crucial context to understand and improve yacht consumption for local communities (SEVINÇ & GÜZEL, 2017; Sezer, 2012). The history of yacht tourism growth in developed countries can be traced back to the 1960s, and its expansion has entered an advanced stage (Paker & Vural, 2016).
Extant online research on yacht tourism in developed countries mainly focuses on issues about impacts of yacht tourism (Alcover et al., 2011; Içemer et al., 2011; MacNeill & Wozniak, 2018; Roma et al., 2019; Stoll et al., 1988), business models of yacht companies (Battistella et al., 2018; Sherman et al., 2008), personnel development, and evaluation in yacht companies (Cha et al., 2013; Koenigsfeld et al., 2012; Paker & Gök, 2021; Sari et al., 2016; Yorulmaz & Sevinc, 2021), tourists’ yacht tourism experience (Lam González et al., 2015; Mikulić et al., 2015; Tseng et al., 2009). However, research on the antecedents for yacht tourism development at a regional level seems to be less discussed.

In developing countries, yacht tourism developed around the 1990s, but its growth rate remains at a relatively low level. For example, the first yacht club established in Shenzhen, China was in 1987, but there were only six yacht clubs in Shenzhen, China by 2019 (Yuboinfo, 2020). According to the National Association of Manufacturers (NMMA), yacht consumption is a natural demand that will emerge when per capita GDP grows to around $3,000 USD per year (Hopkins, 2009). However, the state of yacht tourism in developing countries is highly inconsistent with the country’s economic level. For example, per capita GDP in mainland China has exceeded USD $10,000 in 2019, while some coastal provinces and cities, where the yacht industry is mainly based, have exceeded USD $20,000 (Yao & Luan, 2018). But the total number of yachts in mainland China was only about 6,000 in 2017 (Cruise & Yacht Branch of China Transportation Association, 2017). As such, how to develop yacht tourism remains a paramount issue needed to be addressed in several developing countries (Navarro & Jones, 2022; Cruise & Yacht Branch of China Transportation Association, 2017; Paker & Vural, 2016; Sariisik et al., 2011). Growing academic attention in developing countries has been paid to status analysis and policy/strategy-making to support the development of yacht tourism (Hua, 2004; Sariisik et al., 2011; Wang & Feng, 2005; Wen & Tian, 2013; Yao & Luan, 2017, 2018). For instance, based on the experience of developing yacht tourism in developed countries, Sariisik et al. (2011) applied a SWOT analysis to discuss the development situation in Turkey and proposed strategies to improve the situation. Wen and Tian (2013) applied Potter’s diamond model to analyze the structure of yacht tourism industry chain in Hong Kong and proposed suggestions for the Hainan province on how to develop yacht tourism. A large number of scholars suggest the factors that influence the development of yacht tourism, such as natural conditions (water area) (Sariisik et al., 2011; Wang, 2007; Yao & Luan, 2018), economic conditions (population, GDP, industrial support, etc.) (Cai & Niu, 2010; Yao & Luan, 2018), shipbuilding industry and the number of inbound tourists (Yao & Luan, 2018). However, many scholars call for more academic efforts to enrich the body of knowledge of yacht tourism, especially on the ways to develop yacht tourism industry (Levinska, 2015).

Spatial analysis helps to reveal the characteristics that may be neglected without the visualization process, in turn, to generate new knowledge (Demšar, 2009; Fotheringham & Rogerson, 2009; Waller, 2009). Spatial analysis is a technique of spatial data analysis about the location and morphological characteristics of geographic subjects (Fotheringham & Rogerson, 2009; Wang et al., 2000). In terms of yacht tourism, few works have attempted to delineate the spatial pattern of elements in such an industry (Sidman & Fik, 2005; Yao & Luan, 2018). Yao and Luan (2018) analyzed the spatial distribution of 117 yacht clubs in China and found that the distribution of Chinese yacht clubs was mainly concentrated in the three major economic zones of China. As such, understanding the temporal-spatial pattern of yacht clubs contributed to enriching the body of knowledge of yacht tourism.

Generally, the scale of yacht industry in the United States ranked the first in the world. In 2017, there were about 19 thousand yacht sales and manufacturing enterprises in the U.S., yielding about $95.8 billion (USD), in which, yacht sales accounted for 32.2%, yacht tourism for 21.9%, and related added-value for 45.9% (ICOMIA, 2019). As such, the United States acted as a benchmark in terms of yacht tourism development. Based on spatial analysis and regression model, this study aims to answer two questions: 1) what’s the temporal-spatial pattern of yacht clubs in the United States? 2) What are the driving factors for the development of yacht clubs in the United States? And it provides suggestions for developing countries to improve their policy or strategy making in terms of yacht tourism development.
RESEARCH DESIGN

This study selected yacht clubs in the United States as the research subject. Yacht clubs are the main form of yacht consumption, which is in the pivotal position in the yacht industry, especially yacht tourism (Pongsanukulwech, 2018; Zhou & Zang, 2014). According to British survey data, the income of the mature yacht industry supply chain is mainly composed of upstream equipment and engines (27.1%), yacht manufacturing and sales (37.5%) and yacht consumption services (32.6%) in the midterm (Jiang, 2013). Yacht clubs play a key role in the sales and consumption of yachts (Jiang, 2013). The United States has the largest number of yachts and yacht clubs in the world. The United States accounted for 55 percent of the world’s yacht ownership and had more than 1,300 registered clubs in 2017 (Cruise & Yacht Branch of China Transportation Association, 2017). The development history of yacht clubs lasts for nearly 180 years. Importantly, the data of yacht clubs, such as name, foundation year, longitude and latitude, can be retrieved through open-access websites. Data integrity is guaranteed as www.yacht.com keeps the statistics of yacht clubs, and continuously updates the data.

DATA COLLECTION

Using government and NGO’s official website data as the primary research data is one of the main survey methods for economic research (Waller, 2009; MacNeill, 2018). Some Chinese papers take this survey method as the mainstream method to study the spatial distribution of industries (Yang, 2017; Chen, 2018). Data used in this paper are from the National Oceanic and Atmospheric Administration (NOAA), U.S. Census Bureau, U.S. Bureau of Economic Analysis, www.yacht.com, the official website of each yacht club, Google maps, and Wikipedia. The spatial data collected include the name, foundation year, and longitude and latitude of each yacht club. In total, 1,253 yacht clubs distributed across 50 states in the United States were collected from www.yacht.com. As the longitude, latitude, and foundation year of some yacht clubs cannot be found through the open-access websites, the number of yacht clubs being analyzed in total was 1,047. The factor data for each state of the United States were obtained from the report of National Oceanic and Atmospheric Administration (NOAA), U.S. Census Bureau, and U.S. Bureau of Economic Analysis, including state population, state GDP, state per capital GDP, state tourism GDP, state ocean and lake GDP, state ocean tourism and recreation GDP, state ocean ship and boat building GDP, and state water area. The details of data sources are shown in Table 1.

Table 1. Data Source

| Data type       | Data                                              | Source                                                                 |
|-----------------|---------------------------------------------------|------------------------------------------------------------------------|
| Spatial data    | Names of yacht clubs in the United States         | www.yacht.com                                                          |
|                 | The foundation year of yacht clubs in the United States | Wikipedia, the official website of each yacht club                     |
|                 | Longitude and latitude of yacht clubs in the United States | Google map, the official website of each yacht club                    |
| Economic Factors| State population                                  | U.S. Census Bureau, U.S. Bureau of Economic Analysis                   |
|                 | State GDP                                          |                                                                        |
|                 | State per capital GDP                              |                                                                        |
|                 | State tourism GDP                                  |                                                                        |
|                 | State ocean and lake GDP                           | National Oceanic and Atmospheric Administration (NOAA)                  |
|                 | State ocean tourism and recreation GDP              |                                                                        |
|                 | State ocean ship and boat building GDP             |                                                                        |
| Natural factors | State water area                                   | U.S. Census Bureau                                                     |
DATA ANALYSIS

Based on the time period, this paper analyzed the spatial distribution characteristics of yacht clubs every fifty years, that is, in 1900, 1950, 2000, and 2017. The number of yachts and yacht clubs in the United States are shown in Figure 1. The nearest neighbor analysis and Gini coefficient were used to analyze the feature of spatial cluster. Kernel density analysis was used to identify the center of spatial cluster. The analysis of standard deviational ellipse was used to indicate the directional trends of yacht clubs development. Data analysis approaches were used with the assistance of ArcGIS 10.2 software to visualize the spatial pattern of yacht clubs. The results of spatial analysis in 1900, 1950, 2000, and 2017 will be compared to explore the change of spatial pattern of yacht clubs in the United States. On the other hand, correlation and regression model were applied to explore the driving factors that affect the spatial cluster in different phases. Step-wise regression model was used to identify the degree to which factors drive the development of yacht clubs in recent times.

Figure 1. The number of yachts and yacht clubs in the United States in 1900, 1950, 2000, 2017

Source: ICOMIA (2019); www.yachtclub.com

TEMPORAL-SPATIAL PATTERN OF AMERICAN YACHT CLUBS

American Yacht Clubs Clustered Aggregately and Unevenly.

The Gini coefficient is an important method used to describe the discrete degree of spatial distribution of spatial elements in geography. It can be used to reflect the distribution of one spatial element, or compare the discrete degree of spatial distribution of two spatial elements (Chen, 2018). C refers to the evenness of distribution and the formula is shown below. Theoretically, the Gini coefficient is between 0 and 1. The greater the Gini coefficient of a certain spatial element, the higher the degree of its concentration, and the closer to 0, the more dispersed the spatial distribution. What is widely-acknowledged is that when the evenness of distribution (C) is less than 0.33, the spatial elements analyzed are considered to be distributed unevenly.
\[
Gini = -\sum_{i=1}^{n} \frac{P_i \ln P_i}{\ln N} \\
C = 1 - Gini
\]

According to the calculation, Table 2 shows the evenness of distribution of American yacht clubs in 1900, 1950, 2000 and 2017. The evenness of distribution of American yacht clubs was less than 0.33 in each year. The results indicated that yacht clubs in the United States were distributed unevenly and tends to be more and more uneven in terms of time.

Table 2. The degree of evenness of American yacht clubs in 1900, 1950, 2000, 2017

| Year  | 1900 | 1950 | 2000 | 2017 |
|-------|------|------|------|------|
| Gini  | 0.76 | 0.85 | 0.854| 0.862|
| C     | 0.24 | 0.15 | 0.136| 0.138|

The nearest neighbor analysis was first proposed by ecologists Clark and Evans (1954), and was considered to be suitable for analyzing the irregular distribution of points in a specific space. The nearest neighbor distance is a geographical indicator that represents the proximity of point elements to each other in a geographical space and reflects the spatial distribution pattern of point elements (Waller, 2009). When the point elements are distributed randomly in a geographical space (Poisson distribution type), its theoretical average nearest distance can be expressed by the formula:

\[
\overline{r_E} = \frac{1}{2\sqrt{n/A}},
\]

in which, \( \overline{r_E} \) is the expected average distance, \( A \) is the area of the study space, and \( N \) is the number of point elements. The nearest neighbor ratio \( R \) is defined as the ratio of the observed average nearest distance to the expected average nearest distance: \( R = \frac{\overline{r_i}}{\overline{r_E}} \). When \( R = 1 \), namely \( \overline{r_i} = \overline{r_E} \), the point elements are randomly distributed; When \( R > 1 \), namely \( \overline{r_i} > \overline{r_E} \), the point elements tend to be clustered uniformly; When \( R < 1 \), namely \( \overline{r_i} < \overline{r_E} \), the point elements tend to be clustered aggregately.

In the analysis of the distribution pattern of yacht clubs in the United States, yacht clubs can be abstracted as point elements. According to data, the expected average distance (\( \overline{r_E} \)), the Observed average distance (\( \overline{r_i} \)), and the nearest neighbor ratio \( R \) in 1900, 1950, 2000, 2017 calculated by ArcGIS 10.2 are presented in Table 3. It can be seen that yacht clubs in the United States were clustered aggregately, and the degree of aggregation tends to increase along time. As such, it showed that yacht clubs in the United States were clustered aggregately and unevenly.
Kernel density analysis is a non-parametric estimation method widely used in spatial analysis, which is used to calculate the density of elements in their surrounding areas. This method takes the location of a specific point element as the center, and the density is the biggest at the central position, which decays with distance, and the density is 0 at the limit distance (Waller, 2009; Zhang et al., 2013). By calculating each point element in the region in the same way and superimposing the density at the same position, the distribution density of point elements in the whole region can be obtained (Waller, 2009; Zhang et al., 2013). Its calculation formula is as follows:

\[ f(x) = \frac{1}{nh} \sum_{i=1}^{n} \left( \frac{x - X}{h} \right) \]

In this paper, the number of yacht clubs in different states is assigned to positions, and the states with more concentrated yacht clubs are obtained, as shown in Figure 2:

**Table 3. Results of average nearest neighbor of American yacht clubs in 1900, 1950, 2000, 2017**

| Year | Expected average distance (r_E) | Observed average distance (r_I) | NN Ratio (R = r_I / r_E) | Z value | p value |
|------|-------------------------------|-------------------------------|---------------------------|---------|---------|
| 1900 | 1.280921                      | 0.459711                      | 0.358891                  | -15.8497| 0       |
| 1950 | 0.786844                      | 0.22193                       | 0.28205                  | -33.866988| 0       |
| 2000 | 0.690729                      | 0.155677                      | 0.225381                  | -47.743885| 0       |
| 2017 | 0.885871                      | 0.148214                      | 0.167308                  | -53.335685| 0       |

**The Clustered Centers of American Yacht Clubs Remaining at Metropolitan Cities**

Kernel density analysis is a non-parametric estimation method widely used in spatial analysis, which is used to calculate the density of elements in their surrounding areas. This method takes the location of a specific point element as the center, and the density is the biggest at the central position, which decays with distance, and the density is 0 at the limit distance (Waller, 2009; Zhang et al., 2013). By calculating each point element in the region in the same way and superimposing the density at the same position, the distribution density of point elements in the whole region can be obtained (Waller, 2009; Zhang et al., 2013). Its calculation formula is as follows:

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**Figure 2. Results of kernel density analysis of American yacht clubs in 1900, 1950, 2000, 2017**
As can be seen from the above diagram, the concentration center of yacht clubs in the United States shows a significant trend from the northeastern region to the western and then to the southern regions. Table 4 shows that yacht clubs in the United States clustered mainly in the northeastern region before 1900, including New York state, Massachusetts, New Jersey, and Connecticut. These states had 91 yacht clubs, which accounted for 67% of the total amount of yacht clubs in United States at that time. By 1950, the New York Bay region, including New York state, New Jersey, Maryland, Massachusetts, Connecticut, and Rhode Island had 278 yacht clubs in total, and was still the most concentrated cluster area of the yacht clubs in the United States. However, the proportion of yacht clubs of the New York Bay region fell from 67% to 39%. The two other fast-growing regions were the Great Lakes region (increased from 15 to 167) and California (from 3 to 58). From 1950 to 2000, the growth rate of yacht clubs in the United States tended to be moderate, and the top three clustered regions were New York State (from 130 to 201), California (from 58 to 139), and Florida (from 35 to 87). These regions maintained a rapid growth of yacht clubs. After 2000, the number of yacht clubs tended to be stable generally and the largest relative increase was in Florida, where the number of yacht clubs increased from 87 to 109. From a micro perspective, the clustered centers of yacht clubs were remaining at the metropolitan cities.

Table 4. The clustered regions of American yacht clubs in 1900, 1950, 2000, 2017

| Year | Clustered States |
|------|------------------|
| 1900 | New York state (New York City, Long Island); Massachusetts (Boston); New Jersey (Jersey City); Connecticut (Fairfield, New Haven) |
| 1950 | New York state (New York City, Long Island); Ohio (Cleveland); California (City of San Francisco, Los Angeles); Connecticut (Fairfield, New Haven) |
| 2000 | New York state (New York City, Long Island), California (Los Angeles, San Diego), Florida (Miami, Jacksonville, Tampa), Ohio (Cleveland), New Jersey (Jersey City), Washington (Seattle) |
| 2017 | New York state (New York City, Long Island), California (Los Angeles, San Diego), Florida (Miami, Jacksonville, Tampa), Ohio (Cleveland), Washington (Seattle), New Jersey (Jersey City) |

The Cluster of American Yacht Clubs Moves from the East to the West

Standard deviational ellipse is a common method proposed by Lefever in 1926 to analyze the directional trend of spatial elements (Yang & Grigorescu, 2017; Zhang et al., 2020). The standard deviation on the long and short axes reflect the degree to which features are concentrated around the geographic mean/median centers, and the directional trend of geographic characteristics is reflected by the orientation of an ellipse (Yao & Kim, 2017). The area of the standard deviational ellipse indicates the dispersion degree of research subjects. The smaller the area is, the closer the distribution of research subjects is to the center of gravity (Langworthy & Jefferis, 2000; Zhang et al., 2013). The rotation, which is the measure of the clockwise rotation angle from the arctic direction to the standard deviation ellipse's vertex, represents the longitude direction's primary trend orientation (Yang & Grigorescu, 2017). As shown in Figure 3, the area of standard deviational ellipse of yacht clubs in the United States expanded outward increasingly from 1900 to 2017, which indicated a trend of diffusion. The rotation of the standard deviation ellipse remained between 87.59° and 88.43°, indicating that the diffusion direction of yacht clubs in the United States was from east to west.
This section discusses the factors that drive the spatial cluster of yacht clubs in the United States. As shown above, the developmental trajectory was divided into four phases based on time, including phase I (before 1900), phase II (1900-1950), phase III (1950-2000) and phase IV (2000-2017). Factors that drive the spatial cluster of yacht clubs in each phase will be analyzed separately. As the data of state GDP, ocean economic index can only be retrieved until the 2000s. The main evidence being analyzed for phase I, phase II, and phase III was mainly based on secondary data in the literature. For phase IV, this study applies to the step-wise regression model to explore the degree to which factors drive the development of yacht clubs.

Phase I (before 1900): The Ship and Boat Building Industry Driving the Development of Yacht Clubs

Before 1900, yacht clubs were mainly distributed in the states of New York, New Jersey, Massachusetts and Connecticut. The data that can be assessed were state population and water area of each state in this phase. The correlation result between natural factor (water area) and number of yacht clubs of each state indicated a relatively weak relationship. This suggested that the development of yacht clubs in this phase had little to do with natural environment factors. Additionally, the correlation analysis between the state population data and the number of yacht clubs is moderate, in which correlation coefficient is 0.55. It suggested a relatively strong correlation between state population and number of yacht clubs in each state. Based on the historical documents, the most economically developed state in the United States was New York State from the 17th to the 19th centuries due to the population migration. The population of New York City was 3.45 million in 1900, which was far more than that of other cities. Boston and Baltimore also had a population of more than 500,0001. It can be seen that population cluster was one of the main factors affecting the development of yacht clubs in this phase. An important reason that people clustered at the New York Bay region in the United States was the booming of the ship and boat building industry. In this phase, the New York Bay region of the United States was the center of ship and boat building industry.
States was the main area that produced ships and boats exporting to the United Kingdom, and the booming of the ship and boat building industry attracted a huge boost of population migration to such areas (Wang, 2006). In particular, as the fifth largest city in the United States, Boston was the oldest ship and boat building base in the United States. The first ship in North America was documented to have been built in Boston by as early as 1624 (Wang, 2006). In 1804, one-third of boats and ships in North America were produced in the Boston area (Wang, 2006). In several other regions of the United States with developed shipbuilding industry (Wang, 2006), yacht clubs had also developed on a corresponding scale, such as Wisconsin (6), Michigan (6), and Washington (4).

**Phase II (1900-1950): The Yacht Manufacturing Industry Driving the Development of Yacht Clubs**

In phase II (1900-1950), the correlation result between the natural factor (water area) and number of yacht clubs of each state was still weak. It indicated that the natural environment was not the main factor affecting the spatial cluster of the yacht clubs in the United States during this period. Based on the secondary data, the development of steel industry was found to be the main factor that drove the increase of yacht clubs. From 1900 to 1950, the New York Bay region, with 278 yacht clubs, was still the most concentrated area of yacht clubs in the United States, including New York state, New Jersey, Massachusetts, Maryland, Connecticut, and Rhode Island. However, the Great Lakes region enjoyed the fastest growth rate in terms of yacht clubs growth. For example, Ohio had 75 yacht clubs in phase II, which ranked the second among states in the United States. California ranked the 21st in terms of the number of yacht clubs in 1900 and grew to the third place in 1950; in detail, the number of yacht clubs in California enjoyed the fastest growth during this period (from 5 to 58).

The reason that the Great Lakes region presented with the fastest growth rate in terms of yacht club numbers was that the economic centers of the United States shifted from the New York Bay region to the Great Lakes region. The Great Lakes region was the largest steel industrial base and enjoyed the fastest growth rate in terms of population and economic development in the United States in phase II (1900-1950), where the steel construction industry had become a new economic growth point at that time. The new driving force that resulted in the fast growth of yacht clubs was the booming of steel industry related to yacht manufacturing. It is worth noting that the cluster center of yacht clubs in California during this period was in San Francisco, which was the automobile manufacturing related to yacht manufacturing center of the United States.

**Phase III (1950-2000): Tourism Industry Driving the Development of Yacht Clubs**

According to historical documents, the industrial upgrading of the Great Lakes region after 1950 lead to the relocation of many industries, which led to the economic slowdown and became the famous “Rust Belt” (Wang, 2006). The growth of yacht clubs tended to stall, with the Great Lakes region adding just a dozen. In phase III (1950-2000), the United States went through industrial upgrading, where the tertiary industry developed rapidly, and the manufacturing industry gradually shrank. The development of the tourism industry became an important factor driving the development of yacht clubs. For example, in California, which developed rapidly after 1950, its yacht clubs were mainly distributed in central Los Angeles and southern San Diego, which had large Bay Park and cruise center. Florida, with its rapid economic development since 1980, was a famous holiday resort in the United States. One of the pillar industries of Florida was tourism, and it suggested that the development of yacht clubs has been highly linked to the development of tourism in phase III (1950-2000).

**Phase IV (2000-2017): Ocean Tourism and Recreation GDP Driving the Development of Yacht Clubs**

According to historical documents, yacht clubs were easy to appear in population cluster areas before 2000 (Bairoch, 1995). By 2000, the development of yacht clubs has been in stagnant due to the saturation of the number of yacht clubs in the New York Bay region, Great Lakes region, and
California. Florida was the region with the fastest growth rate in terms of yacht clubs development in the United States. Yachts had become the crucial tourism attraction in Florida, which reversely drove the development of yacht clubs. After 2000, the United States launched the report National Marine Economy Project, which officially issued detailed statistics on the marine economy. As such, this paper applied data from the report of National Oceanic and Atmospheric Administration (NOAA), the U.S. Census Bureau, and the U.S. Bureau of Economic Analysis to test the degree to which various factors were affecting the spatial cluster of yacht clubs in the United States in 2017. Independent variables included state population, state GDP, state per capita GDP, state tourism GDP, state ocean and lake GDP, state ocean tourism and recreation GDP, state ocean ship and boat building GDP, and state water area. Dependent variable was the number of yacht clubs in each state. Step-wise regression model was applied to test their relationship.

It can be seen from Table 5 that the first four equations were significant with p value less than 0.05, of which, the adjusted R^2 of equation 4 had the highest explanatory. However, through collinearity test, it is found that Equation 2 is the optimal regression equation satisfying non-collinearity (VIF is less than 10). The VIF of Equation 4 is greater than 20, indicating a serious collinearity between state population and state tourism GDP. And the VIF of Equations 3 is greater than 10, indicating a serious collinearity between state tourism GDP and state ocean tourism and recreation GDP.

The change in quantity of yacht clubs within each state was influenced by the change of state GDP and state ocean tourism and recreation GDP, with an explanation rate of 75%. According to β value, the regression equation of the number of American yacht clubs can be understood as follow, where X1 for state ocean tourism and recreation GDP, X2 for state GDP:

\[ Y = 0.615 X_1 + 0.316 X_2 + 9.936 \]

It can be seen that an increase of 0.615 unit of the state ocean tourism and recreation GDP and 0.316 unit of state GDP resulted in a unit increase of the number of yacht clubs. Through the step-wise regression model, the excluded variables included state population, state per capita GDP, state tourism GDP, state ocean and lake GDP, state ocean ship and boat building GDP, and state water area. Specifically, state population and state tourism GDP were excluded because they presented with a strong collinearity with state GDP and state ocean tourism and recreation GDP, separately.
DISCUSSION AND CONCLUSION

This paper aims to understand the temporal-spatial pattern of American yacht clubs and driving factors that influence the development of yacht clubs. Spatial cluster is the most important feature of the development of American yacht clubs. Since 1844, American yacht clubs have been concentrated in the New York Bay Area, namely, the southern part of New York State, the northern part of New Jersey, along with Connecticut, and Rhode Island. The New York Bay Area had more than 400 yacht clubs in 2017, about a third of the total in the U.S., and still far outnumbers the rest of the country. Based on the findings on temporal-spatial pattern of yacht clubs, yacht clubs clustered aggregately and unevenly in the United States, and the cluster degree increased across time. The yacht clubs clustered centers still remained at metropolitan cities. The distribution of yacht clubs was in a trend of diffusion and they diffused generally from the east to the west. These results enrich the understanding of yacht consumption in terms of temporal-spatial distribution of yacht clubs in the benchmark country.

In terms of the driving factors for the development of yacht clubs, state GDP was found to be the main factors in the United States. According to the time, this paper divided the development of yacht clubs in the United States into four phases, and the development of industrial agglomeration, including ship and boat building industry, steel industry, tourism industry and ocean tourism and recreation industry, had driven the spatial cluster of yacht clubs. Until 1950, yacht clubs in the United States developed rapidly. The core pillar industry in the United States was manufacturing (ship and boat building industry, and steel industry), so the yacht clubs in states with high manufacturing level developed at a fast growth rate. From 2000, the development rate of yacht clubs tended to be moderate. Along the tertiary industry rises, a new growth of yacht clubs arose in the regions with a strong service industry. Based on the developmental trajectory of American yacht clubs, it can be seen that the development of yacht clubs would done at a fast growth rate in the region where industrial agglomeration was formed. More importantly, once the yacht industry agglomeration is formed, it will maintain a relatively rapid development. In detail, the manufacturing industry (ship and boat building industry, and steel industry) firstly drove the development of yacht clubs, and then the main driver shifts to service industry (tourism industry, and ocean tourism and recreation industry) currently. Different from previous research (Hua, 2004; Jiang, 2013), natural factors (water area) were proved to be less relevant to the development of yacht clubs. The level of economic development has affected the development of the yacht industry (Alcover et al., 2011; Sariisik et al., 2011; Yao & Luan, 2017, 2019), but the difference was that state per capital GDP was proved to be less relevant to the spatial cluster of yacht clubs.

Practically, the developmental trajectory of American yacht clubs offers implications for yacht club development in developing countries. The development of yacht clubs is mainly influenced by the ocean tourism and recreation GDP and state GDP, which is of reference, significant for the development of yacht clubs under the context of developing countries. Industry agglomeration was a main factor that drove the development of yacht clubs. In the initial phase, the manufacturing industry related to yacht consumption, such as the ship and boat industry, drives the cluster of yacht clubs. Along the change of the economic growth point, the tourism industry takes the leading role in yacht consumption, especially relating to ocean tourism and recreation.

Take China as an example. There were 167 yacht clubs in China in 2018(Yao, 2019). This number was similar to that of United States before 1900. In this period, the concentration of yacht clubs was related to population agglomeration in the U.S. China is the country with the largest population and the most significant number of shipbuilding globally, but the yacht industry did not develop as rapidly as the United States around 1900. From the experience of the United States, the slow development of China’s marine tourism has affected the outcome of yacht consumption, thus affecting the whole yacht industry. At present, the research on China’s yacht industry focuses more on the macro perspectives such as policies and systems (Chen, 2013; Yao, 2017; 2019). This research has a certain supplement to China’s yacht industry development.
Turkey is another story. Turkey mainly relies on inbound tourism to develop the yacht industry, greatly affected by seasons (Sariisik, 2011). It should also consider setting up the yacht manufacturing industry and guiding the domestic yacht consumption market.

As such, developing countries are recommended to focus on the region with the manufacturing industry related to the yacht manufacturing and with tourism industry. Specifically, the regions with the potential to develop ocean and recreation industry would be advantageous to develop yacht clubs.

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ENDNOTES

1. Data source: U.S. Census Bureau.
2. Economic statistics from NOAA was recorded in 2016.