

Article

## Towards Marine Spatial Planning in Southern Taiwan

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**Abstract:** Due to population growth, rapid economic development and inadequate marine control, the use of ocean and coastal regions in Taiwan has become more frequent and intense in recent years. However, the lack of comprehensive marine and coastal planning in this island nation has led to many conflicts over space and resources and limited its ability to prepare for and respond to environmental hazards, thus threatening national security as well as the safety and property of its citizens. This study proposes a marine zoning scheme for southern Taiwan. The results show that many important habitats in the southern sea areas have not been properly protected due to the extremely small size of the marine protected area. Furthermore, the majority of the conflicts derive from the exclusive fishing right vs. other uses such as marine conservation. Therefore, it is crucial to establish the marine spatial planning (MSP) for the Southern Taiwan to deal with the conflicts of use seas and uncertainties associated with complex, heterogeneous, and dynamic marine system.

**Keywords:** marine spatial management; marine affairs; marine resource management; coastal management

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## 1. Introduction

The uses of the sea are multifarious and diverse. The development processes of sea uses involving these nine groups of activities, *i.e.*, transport, strategic, mineral and energy, living resources, waste disposal, leisure and recreation, education and research, conservation, and coastal engineering, involve multiple influences of environment, technology, economy, social and temporal change factors interacting in innumerable ways respectively [1]. Sea users extract resources, add pollution, and change species composition. The management and conservation of the world's oceans require synthesis of spatial data on the distribution and intensity of human activities and the overlap of their impacts on marine ecosystems. Halpern *et al.* [2] indicates that no marine ecosystem is unaffected by human influence and that a large fraction (41%) is strongly affected by anthropogenic drivers. This is also leading to conflict between different sea users [3].

The growing pressure on marine ecosystems is not simply a matter of allocating harvestable resources among competing users. Place-based management of marine ecosystem offers a constructive means to deal with the uncertainties associated with complex, heterogeneous, and dynamic systems. Key concepts associated with a place-based approach to managing marine ecosystems include marine spatial planning, ocean zoning, and a number of specific management tools, such as use permits, siting planning, public education, and code of practice. Critical to place-based management is a spatial planning process that increases management's focus on "places", improves recognition of natural systems, and delineates relationships of natural systems to human uses [4].

MSP (marine spatial planning) is emerging as an innovative and potentially central response to serious degradation and conflicting multiple uses of marine ecosystems [5,6]. Drawing on long-standing practices of terrestrial or land-use, planning, MSP seeks to bring a more spatially-specific dimension to the regulation of marine activities, by setting out, for example, preferred geographical patterns of sea uses within a given area. This should be done with the activities are avoided, the most efficient use is made of marine resources, and valuable marine ecosystem are not threatened. MSP is intended to bring about much more coherent and integrated patterns of sea use than has resulted from the typically ad-hoc and sectoral approach to regulating marine activities that has dominated marine management until now [7].

Drawing on the experience of terrestrial planning, it highlights the importance of encouraging stakeholder involvement in MSP, the need to develop a shared vision of a "sea interest". Priorities are then set for research to support this important policy agenda [8]. Hull [9] reviews the progress towards the spatial management of marine resources and finds that there has been considerable collaboration to share data set and to scope the possible conflicts in marine planning zone but it is often difficult to share understanding of these conflicts and to work together to find resolutions. Evolving research and application of MSP, a process described by UNESCO of analyzing and allocating the spatial and temporal distribution of human activities in marine areas, and being applied in a growing number of countries worldwide [10]. MSP holds promise that multiple uses of limited marine space and the interactions among these uses can be balanced to achieve demands for development with the need to protect marine ecosystems. Social and economic objectives can be also achieved in an open and planned way.

There are important marine industries such as shipping and fisheries in southern Taiwan which also has abundant marine resources such as coral reef and beautiful landscape. However, the southern sea area conflicts of marine uses occur primarily between those engaging in fisheries and other user groups,

for example fisheries and marine conservation: many important habitats such as those for coral reefs are located in the exclusive fishery right zone. Therefore, this study proposes a MSP with stakeholder participation in order to deal with the conflicts of use seas and uncertainties associated with complex, heterogeneous, and dynamic marine system in the Southern Taiwan.

## 2. Taiwanese Context

### 2.1. Background

Surrounded by the ocean, Taiwan possesses rich marine environments and resources, and the livelihood of its population is interdependent with the ocean. Between 2002 and 2008, the total production amount for Taiwan's marine industries accounted for 4.76% to 5.73% of the gross national product (GNP), and this percentage was expected to reach 6.41% by 2012 [11]. With a population exceeding 23 million and a limited territory of 36,000 km<sup>2</sup>, of which more than two-thirds is mountainous, Taiwan has a population density of 639 per km<sup>2</sup>. Because land is insufficient and expensive, coastal areas and zones are used for various competing and cooperative purposes by the public and private sectors [12].

The territorial planning in Taiwan includes regional planning, urban planning and national park planning. Although Taiwan is a marine nation, neither the coastal zone nor the sea areas of Taiwan have been properly planned by the Ministry of Interior. Due to lack of marine and coastal spatial planning, the government has included marine resources areas in the draft of the National Territorial Planning Act so as to ensure that sea areas are integrated into the territorial planning system in 2009 for the first time. According to this draft Act, marine resources areas will, in the future, be classified and zoned according to their respective functions such as ports and shipping routes, fishing areas, mineral resource extraction zones, tourism areas, sites in need of coastal engineering, marine protected areas, and special and other functions.

This classification of marine activities, performed by the competent authorities such as the Fishery Agency, will be based on the environmental features and natural resource of Taiwan's internal and territorial waters, the distance from the coastline, and the depths of the sea [13]. This promising development provides a good foundation for the consideration of a fully developed MSP process for Taiwan that, ideally, could exam the conflicts of different sea uses and environment. Research in support of this goal was conducted in a zoning scheme in southern Taiwan and offers insights and recommendations for MSP development throughout the entire country.

### 2.2. Marine Governance

MSP organizations include the national territorial planning authority, the industry competent authority, and local Governments. The Ministry of the Interior, the major national territorial planning authority, is responsible for land management and planning. The industry competent authorities manage sea use according to their allotted rights and responsibilities. Taiwanese waters are mainly used for ports and shipping (ports, routes, and anchoring), fisheries, mineral resources (prospecting and mining), recreation, coastal engineering (submarine cables and pipelines and coastal protection engineering), marine protection (national parks, nature reserves, natural heritage, and non-biological resources

protection, wild animal sanctuaries, fisheries resources protection), sewage discharge, and military activities. The majority of the uses of the sea are regulated by the permit system of various laws and regulations (Table 1). For example, ports and shipping are supervised by the Ministry of Transportation and Communications and the planning and construction of port areas are regulated by Article 6 of the Commercial Port Act. Administrative regulations on route and anchoring areas are stipulated by individual port affair agencies; fisheries use is regulated by local governments and the Council of Agriculture. Article 6 of Fisheries Act stipulates that individuals who intend to conduct fisheries operation in public sea areas and non-public sea areas next to public sea areas have to get the approval from the competent authorities and granted with fisheries permits first.

**Table 1.** Key acts for Taiwan sea use management.

Use Type	Competence Authority	Acts
Ports and Shipping	Ministry of Transportation and Communications	<ul style="list-style-type: none"> <li>Article 9 of the Commercial Port Law stipulates that as for other kinds of operations, permissions from commercial port administrative authorities have to be acquired.</li> </ul>
Fisheries Use	Council of Agriculture and local the government	<ul style="list-style-type: none"> <li>Article 6 of the Fisheries Act stipulates that for individuals who wish to conduct fisheries operation at public sea areas and non-public sea areas connected to public sea areas shall acquire approval from the competent agencies and obtain a fisheries license before starting the operation.</li> </ul>
Mining Resources Use	Ministry of Economic Affairs	<ul style="list-style-type: none"> <li>Article 2 and Article 14 of the Mining Act stipulate that mining resources are considered as property. Thus, mining activities have to be approved and registered with the Ministry of Economic Affairs first.</li> </ul>
Water Recreational Zone	Specific Scenic Sites: Ministry of Transportation and Communications; National Park: Ministry of the Interior; The Rest: the Local government	<ul style="list-style-type: none"> <li>Article 5 of Water Recreational Activity Administration Act stipulates that for water recreational activities whose type, boundary, time, and land use are involved in the jurisdiction of other government agencies, approval should be obtained from those responsible units before the application is processed.</li> </ul>
Coastal Engineering	Submarine Cables and Pipelines: Ministry of the Interior	<ul style="list-style-type: none"> <li>Article 6 and Article 7 of the Law on the Exclusive Economic Zone and the Continental Shelf of ROC for course delineation permission for laying, maintaining or altering of submarine cables or pipelines stipulate that before applying for the permission for course delineation, the cable or pipeline owner shall submit the application to the competent authority for route exploring. After the completion of the mining of the delineated course, the person in charge shall apply for permission for the delineated course from the competent authority.</li> </ul>
	National Park: Ministry of the Interior	<ul style="list-style-type: none"> <li>Article 12–21 of the National Park Act stipulate that persons attempting to use any national park zone should acquire permission or approval from the National Park Administrative Agency.</li> </ul>

Table 1. Cont.

Use Type	Competence Authority	Acts
Marine Protection Area	Nature Scenery: Council of Agriculture and the local government	<ul style="list-style-type: none"> <li>Article 84 of Cultural Heritage Preservation Act stipulates that it is forbidden to alter or to damage the original state of the nature preserved zone. Also, it is forbidden to enter the zone without permission from the competent authority.</li> </ul>
	Nature Heritage and Cultural Scenery: Council for Cultural Affairs and the local government	<ul style="list-style-type: none"> <li>Article 43 of the Cultural Heritage Preservation Act stipulates that to maintain heritages and to preserve environmental scenery, the competent authority shall draw heritage preservation plan with relevant agencies. The planning, zoning, or changing of preservation lands, preservation zones, or lands and zones for other uses shall be conducted according to the Regional Planning Act, the Urban Planning Act, and the National Park Act.</li> </ul>
	Wildlife Conservation Zone: Council of Agriculture and the local government	<ul style="list-style-type: none"> <li>Article 8 of the Wildlife Conservation Act stipulates that for any exploitation at important wildlife habitats, the person in charge shall submit application to the central competent authority via the local one. After receiving the approval, the person in charge shall apply for approval from the competent authority.</li> </ul>
	Fisheries Resources Protection: Council of Agriculture and the local government	<ul style="list-style-type: none"> <li>Article 45 of the Fisheries Act stipulates that the competent authority shall specify conservation zones for animals and plants breeding. The setup of the animals and plants breeding zone shall be reviewed by the municipal authority. Alternatively, its conservation zone management plan can be submitted by the city/county authority to the central authority for approval and announcement.</li> </ul>
	Environmental Protection Administration	<ul style="list-style-type: none"> <li>Article 20 – 21 of the Marine Pollution Control Act stipulate that individuals who wish to carry out ocean dumping or ocean incineration shall apply for permission from the central administrative agency (Environmental Protection Administration) and perform the operation at areas specified by the central administrative agency.</li> </ul>
Pollution Discharge Zone	Ministry of National Defense	<ul style="list-style-type: none"> <li>According to Item 1 of Article 5 and the enforcement rules of Article 25 of the National Security Act, the Ministry of National Defense and the Ministry of the Interior shall delineate and announce costal restriction zone of the coastline of Taiwan based on the actual marine defense requirements.</li> </ul>
Military Use Sea Area		<ul style="list-style-type: none"> <li>According to Item 1 of Article 5 and the enforcement rules of Article 25 of the National Security Act, the Ministry of National Defense and the Ministry of the Interior shall delineate and announce costal restriction zone of the coastline of Taiwan based on the actual marine defense requirements.</li> </ul>

According to the Regional Planning Enforcement Rules and Rural Land Use Control and Planning Regulations of Taiwan made by the Ministry of Interior (MOI) in 1978 and 1976 individually, rural lands have to be zoned into ten zones such as agricultural, general agricultural, or industrial zones. Sea areas, however, were not covered in these regulations. To deal with the competition for sea areas use, the Construction and Planning Agency of the MOI included sea areas and coastal regions (offshore sea areas) into the regional planning for implementation in the second overall review of regional planning in 2009 [14].

Taiwan's jurisdictional sea area has already been included into the Land Law, which was enacted in 1930 and has been amended nine times since then. According to the law, lands can be classified into building lands, lands for direct production, lands for transportation, lands for water conservation, and lands for other purposes. In response to the United Nations Law of the Sea Convention, Taiwan passed the Law on the Exclusive Economic Zone and the Continental Shelf of the Republic of China in 1998, and proclaimed the baseline, territorial sea, contiguous zone, exclusive economic zone (EEZ), and continental shelf of the country. Nevertheless, since Taiwan has not yet created a boundary with its neighboring countries, no demarcation line has been drawn between the EEZ and the continental outer shelf of Taiwan and its neighboring countries.

Encouragingly, a draft Coastal Act, which would provide legislative support to sea-use planning, was developed in 1991 and has been sent to the Legislative Yuan for review in 1997, 2000, 2002, and 2008. Unfortunately, it has been rejected every time due to the fishermen's opposition to it. Fishermen are afraid that they will lose their fishing rights because of new protected zones. Under the proposed Act, waters under planning jurisdiction would extend either from the high water mark seaward to the 30 m bathymetric line, or 6 km seaward using the longest distance as the boundary without crossing beyond the territorial sea and sea floor. It was also planned to set up first-level and second-level coastal protected zones and collect regulations and comments from relevant agencies, groups, and individuals for drawing out the coastal protection plan to guard special marine resources as well as the safety and properties of the people.

The Draft of the National Territory Planning Act proposed by the Ministry of Interior in 2013 states that the land use zones are divided into national territory conservation zones, marine resource zones, agricultural development zones and, city and county development zones base on the attributes of land resources. Furthermore, the marine resource zones are divided into three categories. The first category includes the sea areas which have valuable, special or unique marine resources. Sea areas with exclusive sea uses belong to the second category. Sea areas needing to be categorized belong to the third category.

### 3. Methodology

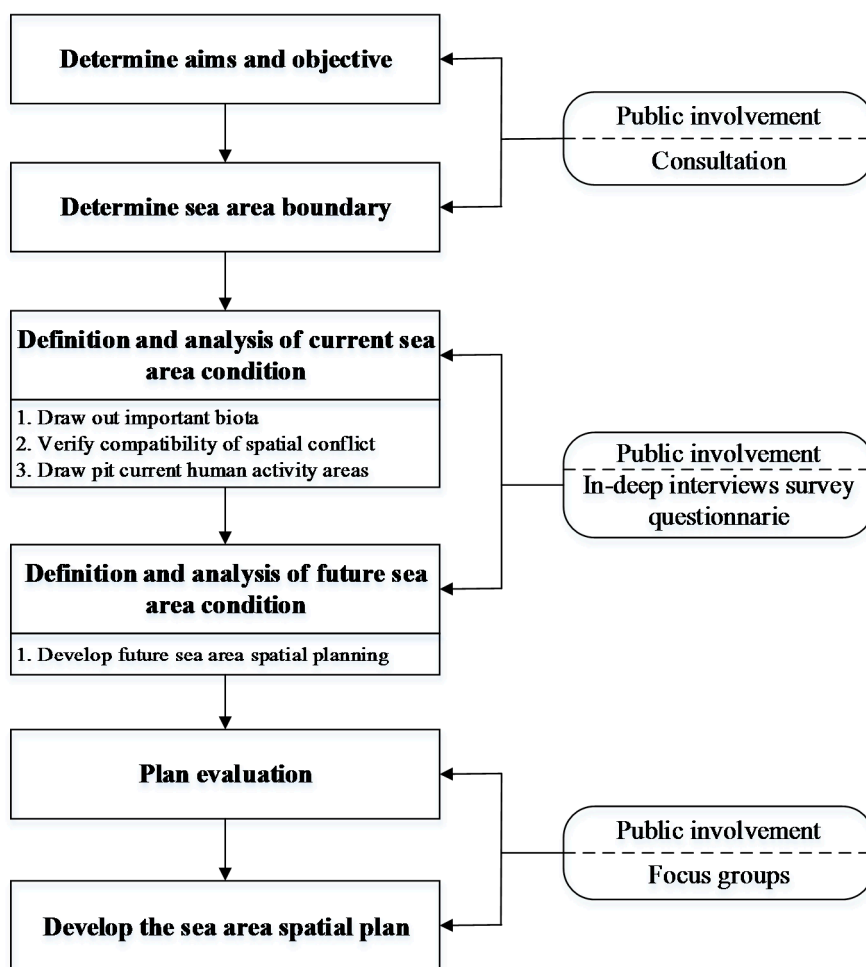
This study analyzed the existing management system of Taiwan. Furthermore, a zoning scheme for southern Taiwan was developed with the zoning method proposed by Boyes *et al.* [15]. Marine zoning schemes include two types. The first is specific use zoning schemes. For example China has carried out functional zoning of sea areas within the Territorial Sea. The Marine Multi-Function Zoning scheme has been established to zone sea areas according to their functions, location, natural resources, environmental conditions, and exploitation demands, to provide appropriate planning for the use of sea areas scientifically based on sea area use management and marine environmental protection [16]. In Taiwan,

researchers when carrying out marine zoning research consistently adopt the Chinese ocean functional zoning approach. The second pattern is the simple zoning scheme. For example, the United Kingdom (UK) has enacted national marine legislation, partly including MSP. Part of Irish Sea was used as a pilot study to assess MSP approach for the UK [15,17]. The authors employed the method proposed by Boyes *et al.* [15] for zoning in this study, because the method is a proposed multiple-use posteriori zoning scheme and is easy to identify where interactions and potential conflicts of sea uses in Taiwan. The different sea uses can be co-located in the same areas. In this method, the sea is divided into the following four areas: general use area, conservation priority area, exclusive area, and protected area.

Questionnaires were developed and sent to local Government and other competent authorities such as the Kaohsiung Harbor Bureau, which use the sea areas of southern Taiwan to collect information on the current and future sea uses. The GIS information related to sea uses was provided in the questionnaires by the local Government and other competent authorities. In addition, sea use issues were further investigated through in-depth interviews. The interviewees including key stakeholders related to sea use are interviewed personally (Table 2). Finally, the outcome of a proposed zoning scheme was evaluated using the focus group method (Figure 1). In this study, a focus group was chosen as an evaluation tool to understand the outcomes of a zoning scheme. The group was composed of 12 important stakeholders from different sectors. According to Stewart and Shamdasani [18], in order to acquire the most reliable answers, the number of stakeholders shall not exceed 12 persons. The focus group session, carried out in November 2010, lasted for two hours, with time divided equally in the discussion of two questions that were introduced through a questioning route or discussion guide. One scholar in the group acted as the facilitator who reviewed the objective of the focus group and developed questions. These questions then acted as the guide for the group. The focus group data was collected and analyzed using content analysis.

**Table 2.** Characteristics of interviewees.

Interviewees	Job Location	Professional Title	Main Sphere of Interest
Interviewee 1	Chiayi Fishermen Association	Section Chief	Fisheries
Interviewee 2	Fisheries Section of Chiayi County Government	Section Chief	Fisheries and Marine Conservation
Interviewee 3	Danggang Fishermen Association	Chief Secretary	Fisheries
Interviewee 4	Dapeng Bay National Scenic Area Administration	Chief Secretary	Tourism and Marine Conservation
Interviewee 5	Kaohsiung City Marine Bureau	Commissioner	Marine affairs
Interviewee 6	Kaohsiung Harbor Bureau	Master	Navigation
Interviewee 7	Kenting National Park Headquarters	Section Chief	Tourism and Marine Conservation
Interviewee 8	Hengchun Fishermen Association	Director	Fisheries
Interviewee 9	Agriculture Department of Pingtung County Government	Associate Director	Fisheries and Marine Conservation
Interviewee 10	Penghu County Government Agriculture and Fisheries Bureau	Section Chief	Fisheries and Marine Conservation
Interviewee 11	Penghu National Scenic Area Administration	Former Director	Tourism and Marine Conservation
Interviewee 12	Tainan City Fisheries Section	Section Chief	Fisheries and Marine Conservation

**Figure 1.** Marine spatial planning (MSP) structure and procedures in southern Taiwan.

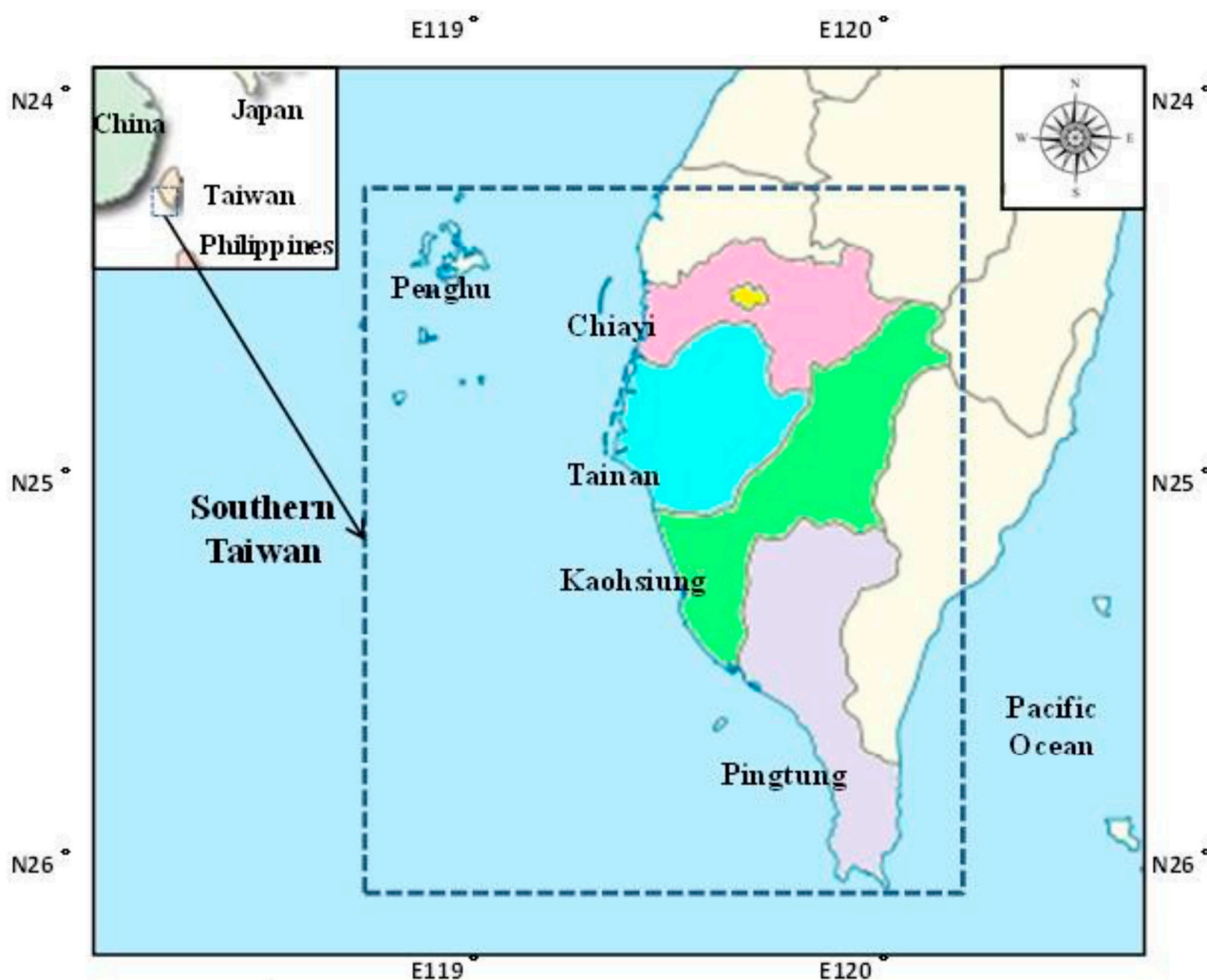
## 4. Key Issues in the MSP in Southern Taiwan

### 4.1. Specification of Sea Boundaries

The lack of a definite internationally recognized political status of Taiwan as a nation has rendered official demarcation with neighboring countries impossible. The boundary is defined according to the recommendation drawn from the Sea Area Function Zoning System Structuring Seminar in Taipei, Taiwan in October 2005 and the demarcation practices employed by Ireland. Therefore, the sea areas for this study are assigned as between the average high water mark of the southern counties and cities and the boundary of the territorial waters. Taiwan is divided into four districts according to the Taiwan Area Comprehensive Development Plan proposed by the Department of Urban and Housing Development of the Council of Economic Planning and Development [19]. The southern region of Taiwan as defined by the government includes Chiayi County and City, Tainan City, Kaohsiung City, Pingtung County, and Penghu County (Figure 2).



Figure 2. Geography of southern Taiwan.



#### 4.2. Status Quo of Sea Uses

The current uses of the sea areas are multiple and complicated because of conflicts between stakeholders. Based on the GIS information obtained from the survey questionnaire, the current uses of southern sea area are mapped as shown in Figure 3. According to the in-depth interviews, the southern sea area conflicts of marine uses occur primarily between those engaging in fisheries and other user groups: (1) fisheries and marine conservation: many important habitats such as those for coral reefs are located in the exclusive fishery right zone (Figure 2), thus it is difficult to establish marine protected areas in those areas (Interviewee 10, 11); (2) fisheries and navigation: conflicts between oyster raising in demarcated fishery right zones and shipping in the coastal region of Chiayi County (interviewee 1, 2); (3) fisheries and defense: conflicts resulting from the competition between fishing operations and artillery firing in the sea areas of Hengchun (interviewee 8) (Table 2). During one third of each year, fishing at artillery firing zones is not allowed, as the zones overlap with an exclusive fishing right zone at Hengchun, Pingtung. The result of interview revealed that that many important habitats such as those for coral reefs are located in the exclusive fishery right zone, thus it is difficult to establish marine

protected zones in those areas. Furthermore, there are still fishing activities in some marine protected areas such as Kenting National Park, where fishing is not allowed.

**Figure 3.** Status quo of sea use in southern Taiwan.

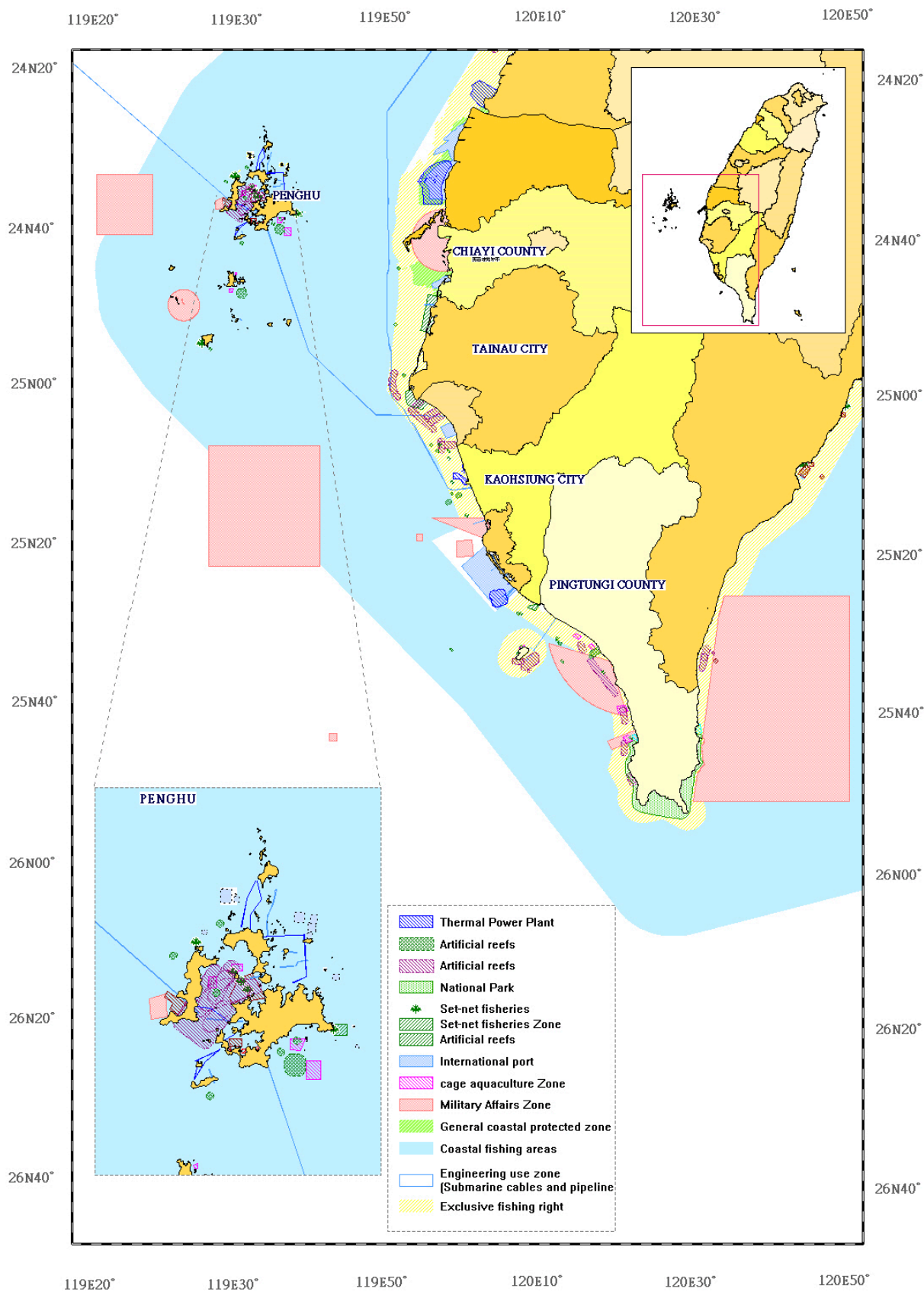
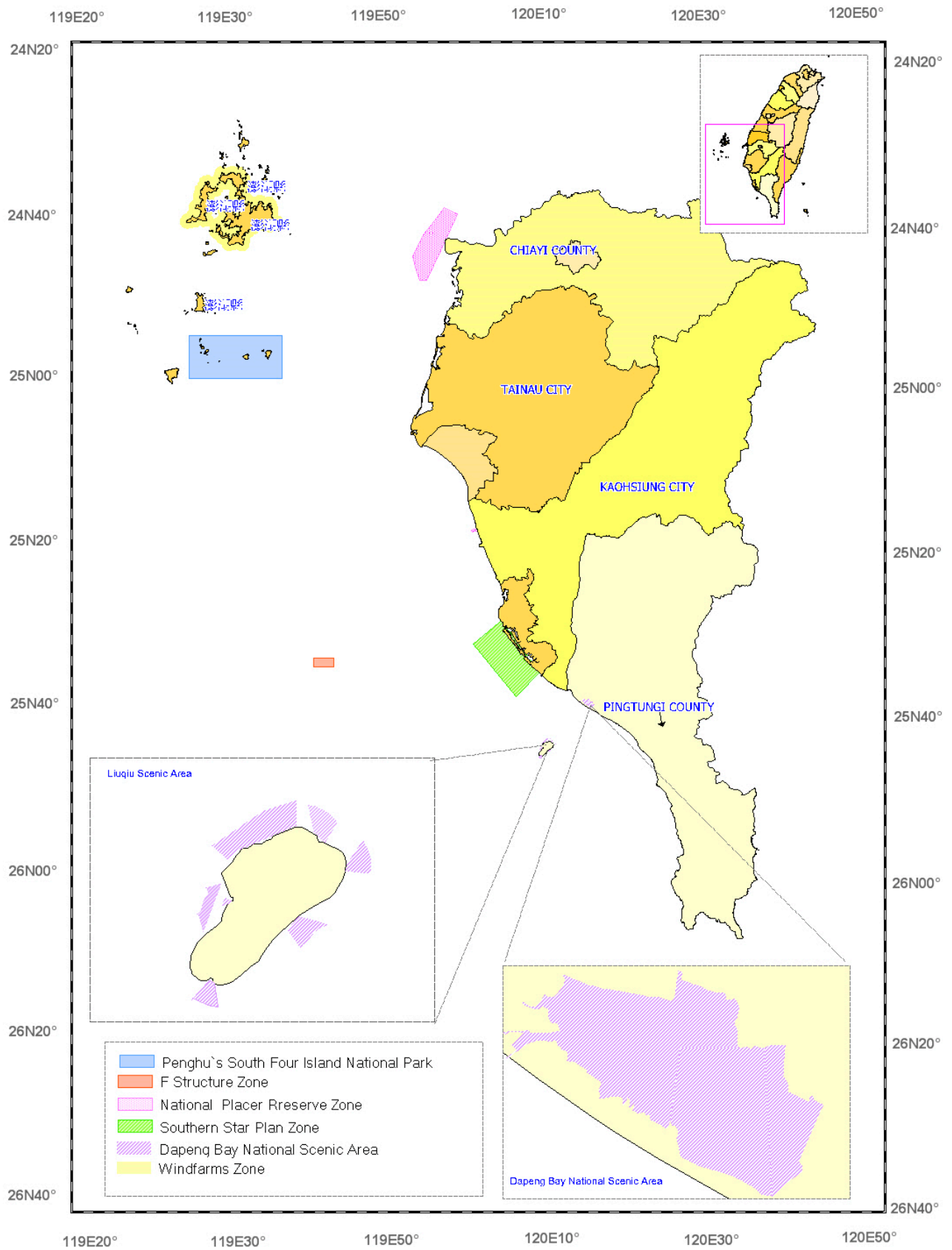


Figure 4. Future plan for sea use in southern Taiwan.



### 4.3. Future Plan for Sea Uses

Based on the above GIS information obtained from the survey questionnaires, the future planning of the southern sea areas are mapped as shown in Figure 4. The purpose is to understand the time and spatial requirement of humans and to estimate new time and spatial demands on the use of marine space. With regard to future planning, the focus will be placed on the conservation zone for the marine national park headquarters at the sea areas of Penghu's South Four Isles, which is a new and important conservation measure in Southern Taiwan [20]. Nevertheless, the majority of the coral reefs and wetlands are still not protected because of these measures. For the development of offshore wind power plants in southern Taiwan, the Sustainable Energy Policy Program of 2009 has proposed to set up offshore wind power plants in areas around Penghu and Changhua. The Energy Bureau has also planned to complete a 74-megawatt wind power facility in 2013. To keep up with this demand, the Energy Bureau of the Ministry of Economic Affairs stated that Taipower will complete the laying of submarine cables from Taiwan to Penghu in 2014 to ensure a stable supply of wind power. For natural gas and petroleum, the government has planned to carry out petroleum and natural gas development plan for the F structure at the open sea of Kaohsiung and at the Taichao structure mining [21]. Petroleum pipelines and submarine cables in the sea areas of Taiwan are web-like and are extensively distributed. The Kaohsiung City Government has proposed the Southern Star Plan in order to maintain the competition ability of Kaohsiung Harbor. In addition, in the Southern Start Plan, a free trade zone will be set up to promote economic activities in the port area [22].

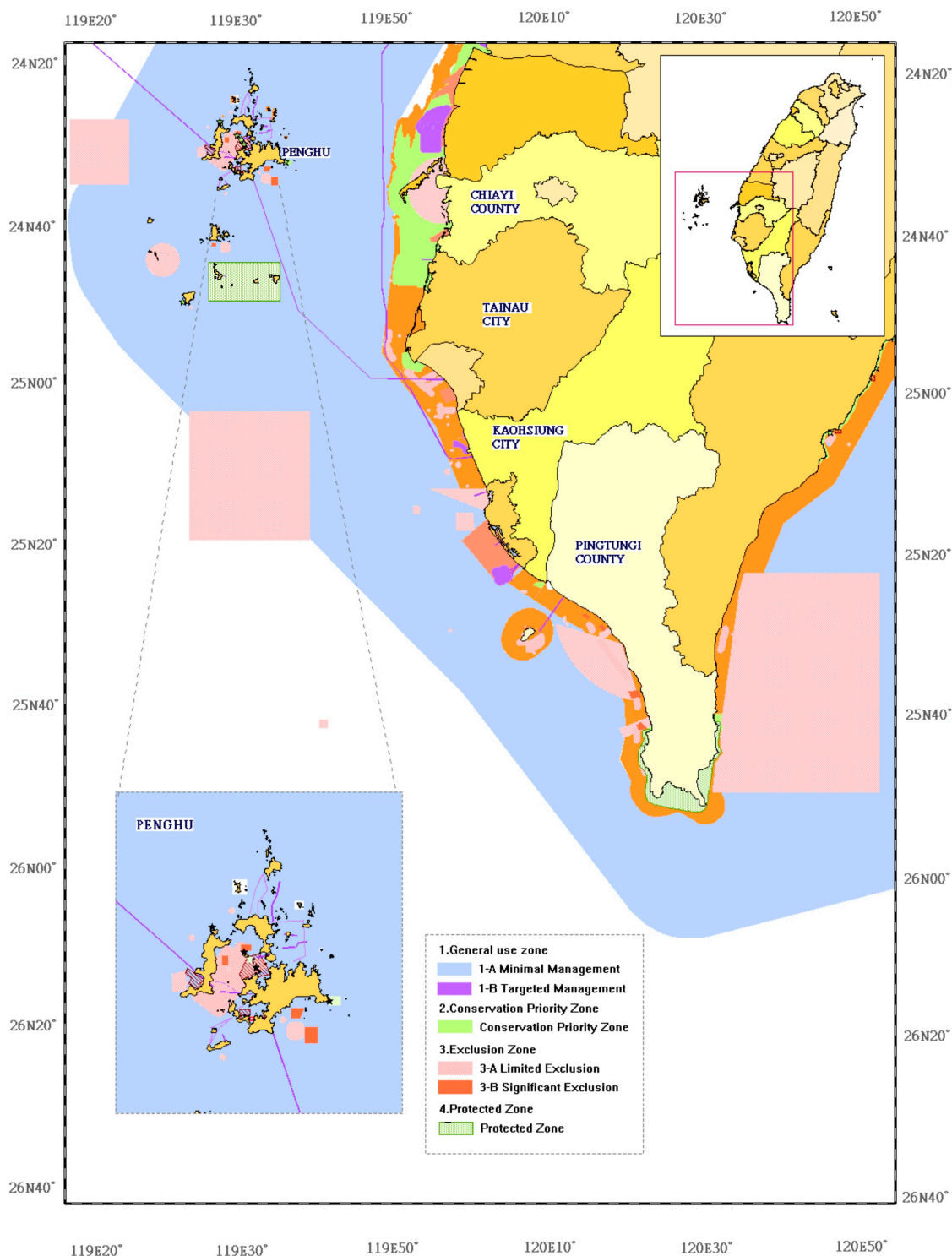
## 5. A Proposed Zoning Scheme in Southern Taiwan

According to the zoning method proposed by Boyes *et al.* [15], as stated earlier there are four zones: general use zone, conservation priority zone (CPZ), exclusion zone (EZ), and protected zone (Figure 5 and Table 3).

### 5.1. General Use Zone

General use zone can be further divided into 1-A (minimal management, MM) and 1-B (targeted management, TM) subzones. 1-A zone covers general sea area use. Most activities conducted in this area need to be permitted by international laws and regulations for using the resources within the zone. The areas mainly include the general coastal fisheries zone, navigation zone and marine recreation zone. The ratio of 1-A zone to the territorial sea is 90.75%. Individuals need to acquire a license or a permit from the competent authority before operating in the 1-B subzone. This area covers the engineering use zone. Taiwan has devoted itself to developing green energy and establishing offshore wind power plants at Chunghwa and Penghu. The generated electric power will be delivered to the land by submarine and cables, which will take some space within three nautical miles from the coast. The ratio of 1-B zone to the territorial sea is 0.01% (Table 3).

Figure 5. Marine spatial planning in southern Taiwan.



### 5.2. Conservation Priority Zone (CPZ)

The existing CPZ of Taiwan overlaps significantly with the general use and the exclusion areas. Given that there is no way activities conducted at sea areas could be automatically restricted, monitoring, evaluation, and control are necessary for regulating the use of resources. Any use or exploitation in CPZ has to be permitted by the management departments to ensure that laws are obeyed by the applicants. The exploiters have to provide certificates or evidence demonstrating that the use of sea areas would not

pose a negative effect on the present environment. After obtaining the approval, the users can only perform activities within the specified range in CPZ. This zone includes mainly the coastal natural protection areas, and the ratio of the zone to the territorial sea is 0.68% (Table 3).

**Table 3.** Relative proportions of each zone in the MSP of southern Taiwan.

Zone	Name	Area (km <sup>2</sup> )	Total area (km <sup>2</sup> )	Proportion
Zone 1-A (General use zone)	Coastal fishing areas	14,949.83	14,949.83	90.75%
	Marine recreational zone			
	Navigation area			
Zone 1-B (Targeted management zone)	Engineering use zone (Submarine cables and pipelines)	96.40	96.4	0.01%
Zone 2 (Conservation priority zone)	General coastal protected zone	111.74	111.74	0.68%
Zone 3-A (Limited exclusion zone)	Military zone	3064.00	3717.64	22.53%
	Artificial reefs	631.70		
	fishery resources Conservation	21.94		
Zone 3-B (Significant exclusion zone)	Exclusive fishing right	2108.90	3190.89	19.35%
	Demarcated fishing right zone	289.10		
	Set net fishing right zone—Usage zone of set net	369.28		
	Navigation	309.18		
	Economic use zone	113.30		
	Southern Star Plan	1.13		
Zone 4 (Protected zone)	South Four Isles Marine National Park	265.80	449.32	2.73%
	Kenting National Park	152.06		
	Coastal natural protected zone	31.46		

Note: 1. Total area: the total area in each zone. 2. Proportion: the area of each zone to the area of territorial sea in the southern Taiwan.

### 5.3. Exclusion Zone (EZ)

Exclusion Zone can be divided into 3-A (limited exclusion, LE) and 3-B (significant exclusion, SE) subzones. Limited exclusion subzone can be divided into three types. The first type is military restricted areas; the second one is the artificial reefs areas, and the last one is fisheries protection area with temporary or permanent ban on specific fishing activities. Significant exclusion subzone is an area that restricts activities conducted in the area through laws in order to maintain the safety in the area. Exploitive activities are banned in this area. This area is mainly used for exclusive fishing right, demarcated fishing right, set net fishing right, navigation, economic use, and Southern Star Plan. The ratio of the zone to the territorial sea is 29.70% (Table 3).

### 5.4. Protected Zone (PZ)

Almost no activity is permitted in PZ, with only a few exceptions. These permitted activities generally share some research purposes, but for areas with more serious damage or with higher sensitivity,

researchers have to obtain permission before conducting research of any kind [23]. A large part of this area is protected by the National Park Act and the Coastal Natural Environmental Protection Project. Examples include the coastal natural protected zones, Kenting National Park and the oncoming Southern four Isles Marine National Park. The ratio of the zone to the territorial sea is 2.73% (Table 3).

### 5.5. Evaluation of a Zoning Scheme

The following results are analyzed according to a focus group method mentioned in the methodology section.

(1) Who should be in charge of the authority of Marine Spatial Planning in Southern Taiwan?

Comments were refined by finding a meaning to the comments, condensing the meaning and finally the following two themes emerged: authority of a zoning scheme and authorities of sea use management.

According to the draft of National Territory Planning Act, the Ministry of Interior should formulate, announce, change and implement the national territory plan, which includes the water under Taiwanese jurisdiction. However, an Ocean Affairs Council will be established for policy integration in the near future. As such the group felt that the authority should be transferred to this council with the power to integrate marine policies from different sectors.

The focus group recommended that different sectors of sea use should manage their own activities based on zoning maps, permit systems and other managing measures.

(2) Will this proposed zoning scheme be feasible?

The answers were reduced to one theme: feasibility. This zoning scheme proposed by Boyes *et al.* [15] is feasible. People can understand the meanings of different zones and follow their managing measures the easily in this zoning scheme. Furthermore, several areas with conflicts may be properly solved. For example, some important habitats such as the Southern four Isles Marine National Park are included in MPAs. The general coastal protected zone is included in the conservation priority zone. Some important habitats should be further considered to be included in the conservation priority zone or protected zone in order to protect the ecosystem and restore fishery resources by the authority of MSP. Secondly, the demarcated fishery right zone is included in the significant zone, the navigation will not be allowed in this zone. In addition, the military zone is included in the limited exclusion zone. Fishermen can go fishing in this zone except during the periods when maneuvers perform. In sum, it is more feasible for Taiwan to adopt the simple zoning scheme than the multi-function zoning scheme because the latter may restrict other uses because of sectionalism [24], especially for marine fishing operations around Taiwan.

## 6. Discussion and Conclusions

There are several benefits to adopt this zoning scheme proposed by Boyes *et al.* [15]. Firstly, it is possible to identify where interactions and potential conflicts are likely to arise and the extent to which existing measures could avoid or minimize conflict between activities and important marine habitats. According to the present zoning system, there are only conservation priority zones and protected zones in southern Taiwan, and the size of these zones is quite small. Even though coral reefs and wetlands habitats abound there, few are included in the conservation priority zone and protected zone (less than 0.68% of the total territorial area) (Table 3). Therefore, it is important to add these valuable habitats into the conservation priority zone or the protected zone. In the governments' future planning, only the

Marine National Park Headquarters will set the water area of Penghu's South Four Isles as a marine protected area (MPA); while other important habitats have been neglected altogether. Consequently, Taiwan is still far from reaching the goal for 2020, *i.e.*, attaining a MPA surface area that accounts for 20% of the territorial sea area [25].

Different sea uses can be mostly accommodated mutually by using this zoning scheme. For example zone 3A to segregate the artillery firing and fishing operation with different time scales in the same zone. In contrast, the specific use zoning schemes such as that of China may restrict different uses in one specific use zone due to sectionalism. Furthermore, it also provides a "benchmark" against which to consider policy development and any planned or "determined" zoning scheme that might be developed. The government should set up reasonable time and spatial arrangement for sea use to integrate developments of different sectors [26], thereby bringing ecological, environmental, economic, and social advantages [10]. In doing so, Borger *et al.* [27] propose the application of ecosystem service valuation to MSP so that marine planners, managers and decision makers will have interest in, and confidence in using economic information that is provided to support their MSP efforts. Finally, it is practical and feasible to carry out this zoning scheme, especially in the condition of lack of basic data of marine environment and ecosystem.

However, there are still some challenges and impediments concerning such a proposal. According to Article 29 of the Fisheries Act of Taiwan, approval of fishing rights can be modified, removed or terminated on the grounds of national defense and conservation of aquatic resources. For the loss caused by the first action, competent authorities or the department requesting such modification, removal, or termination should work on the negotiation for subsequent compensation. Should negotiation fail, the central authority should make the final decision. At this stage, unfortunately, the government agencies still perform poorly in negotiation, leading to a competitive use of sea areas. Therefore, a stakeholder engagement process that encourages fishermen's participation, collaboration and communication is at the heart of effective MSP [28]. In cases of development of wind farms around the British Isles, co-location of certain activities, MPAs, aquaculture and commercial fishing has therefore been proposed as an option to ease demands on spaces [29]. This is to enable both spatial planning and where necessary mitigation in an increasingly crowded marine environment, for example co-location of offshore wind farm and MPAs [30]. This suggests potential for incorporation of offshore wind farms as no fishing, or restricted activity zone within a wider MPA to aid fisheries augmentation.

The development of appropriate administrative and legislative mechanisms is required to allow the implementation of a zoning scheme, within a priori MSP system which requires a more proactive policy-led approach [18,31]. According to the draft of National Territorial Planning Act Regulations, MOI is in charge of Taiwan MSP and the administrative functions, and sea areas shall be included in territorial planning via the regional plan. After the organizational reform of the Executive Yuan in 2012, an Ocean Affairs Council will be established for the integration, coordination, and promotion of marine affairs. In this case, MSP and management will be an excellent tool for integrating, planning and coordinating marine management for the Council.

Furthermore, the practice of exclusive fishing rights originated in the Japanese colonial era as a measure for protecting conventional coastal fisheries. The proposed multi-function zoning scheme has become an impediment to the use of other sea areas. For the planning and management of exclusive fishing rights in the future, it is important to take into account what actually is needed by the fishermen,



the location of the fisheries area, and the needs for protecting fisheries resources. It is also crucial to encourage fishermen to support the MPA zoning because it is beneficial for the formation of the fisheries area and the cultivation of fisheries resources. By doing so, sustainable fisheries development as well as marine resource conservation can both be achieved.

The most serious conflicts related to sea area use come from the competition between exclusive fishing rights and MPA zoning, as well as those between fisheries and military use. Exclusive fishing rights are an excellent tool for protecting the livelihood of the minority fishermen in the coastal region, but as sea use becomes more diverse, exclusive fishing rights could become an impediment to the development of other uses [32]. To strike a balance between protecting the right of the fishermen and the development of other uses such as ecological conservation [33], it is crucial to encourage fisherman to establish their own MPAs like Japanese does, thereby rationalize marine use.

The most common issue seems to be that extending the scope of MSP to cover all marine activities, in line with the underlying principle of integrated management. In some countries, MSP remains primarily concerned with marine nature conservation. Taiwan's MSP experience indicates that MSP can find conflicts of different sea use and marine environment. It is to be hoped that MSP can contribute to the recovery of waters facing the consequences of rapid industrialization and to the careful use of marine resources. This suggests that MSP is a flexible process, capable of being adapted to implement a range of objectives. This is in line with the framing of MSP in academic literature, where it is constructed as a means of rationalizing the use of marine space to implement various marine policy priorities, including conservation and economic objectives [7].

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## Author Contributions

In this paper, Meng-Tsung Lee designed the research programs, provided for the technology of GIS software, analyzed the results and wrote of the Introduction, Methodology and Results. Chin-Cheng Wu committed to implement the data collection, interview survey and analyzed the survey result. Ching-Hsien Ho carried out the data collection, drawn and analyzed of the figure by GIS software. Wen-Hong Liu conceived of and developed the research framework and wrote the session of Discussion and Conclusion.

## Conflicts of Interest

The authors declare no conflict of interest.

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