

**AN EVALUATION OF TIOMAN ISLAND
MARINE PARK ZONING PROCESS**

by

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LIST OF ABBREVIATIONS

EIA	Environmental Impact Assessment
EQA	Environmental Quality Act
GBR	Great Barrier Reef Marine Park Authority of Australia
MP	Malaysia Plan
MPA	Marine Protected Area
MSP	Marine Spatial Planning
NACMPMR	National Advisory Council for Marine Parks and Marine Reserves
NST	New Straits Times
SCUBA	Self Contained Underwater Breathing Apparatus
UNDP	United Nations Development Programme
WWF	World Wide Fund for Nature

SATU PENILAIAN TERHADAP PROSES PENGEZONAN TAMAN LAUT PULAU TIOMAN

ABSTRAK

Malaysia telah menjadi satu destinasi pelancongan bagi pelancong dalam negeri dan pelancong dari luar negara. Kerajaan Malaysia telahewartakan Taman Laut pada tahun 1994, di bawah Akta Perikanan (1985), untuk melindungi dan membentuk satu sistem pengurusan Taman Laut yang mampan. Walau bagaimanapun, disebabkan oleh proses pengezonan dan pengurusan yang lemah beberapa Taman Laut yang terkenal di sekitar Malaysia telah ditutup. Pengezonan Taman Laut ialah satu kaedah untuk melindungi biodiversiti biologi dan untuk memastikan kemampanan hidupan laut.

Kajian ini melihat dasar dan amalan proses pengezonan di Pulau Tioman dan mencadangkan proses pengezonan yang terbaik ke arah mewujudkan satu pengurusan Taman Laut yang mampan di Pulau Tioman. Khususnya, kajian ini akan melihat proses pengezonan Taman Laut, yang termasuk tahap pengezonan, jenis-jenis pengezonan, dan fungsi pengezonan. Kajian ini menggunakan pendekatan pelbagai kaedah yang menggabungkan tiga kaedah termasuk menggunakan data sekunder daripada laporan yang telah disediakan bagi Pulau Tioman, mengadakan temu bual dengan responden-responden yang terlibat dengan pengurusan dan pengezonan Pulau Tioman, dan melakukan pengamatan di tapak bagi mengumpul data berkaitan pelaksanaan dan pengurusan Taman Laut Pulau Tioman.

Hasil kajian telah menunjukkan pelan pengezonan yang disediakan dalam laporan sekunder kurang berkesan untuk mengawal aktiviti di Pulau Tioman.

Sementara itu, hasil pengamatan di tapak pula menunjukkan pengawalan aktiviti di Pulalu Tioman lemah dari segi pelaksanaannya. Hasil daripada temu bual juga menyokong penemuan kajian, dan responden bersetuju bahawa penambahbaikan kepada proses pengezonan akan mewujudkan Taman Laut yang mampan.

AN EVALUATION OF TIOMAN ISLAND MARINE PARK ZONING PROCESS

ABSTRACT

Malaysia has become a tourist destination for domestic and foreign tourists. The Malaysian government has gazetted its Marine Parks in 1994 under the Fisheries Act (1985), to protect and to ensure a sustainable management of Marine Parks. However, due to the weaknesses in the zoning process and in the management system, some famous Marine Parks around Malaysia have been closed. Zoning of Marine Park is a method to protect the biological biodiversity and to ensure the sustainability of marine lives.

This study looks at the current policy and practice of Marine Park zoning process in Pulau Tioman and proposes a proper marine park zoning process to achieve a sustainable Marine Park management system in Pulau Tioman. Specifically, this study will look at the Marine Park zoning process, which includes the zoning stages, the types of zoning, and the zoning function. This study adopts a multimethods approach comprising three methods of using secondary data from the report prepared for Pulau Tioman, conducting interviews with the respondents involved in the management and zoning of Tioman Island, and making site observations, to collect data regarding the implementation and management of Tioman Island Marine Park.

The results proved that zoning plan prepared in the secondary reports were ineffective in controlling the activities on the Pulau Tioman. Meanwhile, the site observation on Tioman Island showed that the activity control on the Marine Park

was weakly implemented. Results from the interviews also supported the findings, and the respondents agreed that improved zoning process will create a sustainable Marine Park.

CHAPTER 1

INTRODUCTION

This introductory chapter provides a brief introduction to the research study. It begins by providing the scenarios of the tourism activities in Malaysia and later focuses on Marine Parks. Then, this chapter introduces the aim and objectives of this study. Subsequently, the research question of this study is elaborated, followed by the definition of key terms used in this study. This chapter ends with the conclusion.

1.1 Background of the Study

The development of the tourism industry in Malaysia has been encouraging. The number of tourist arrivals in Malaysia has increased steadily over the years. Malaysia has successfully placed itself on top of the list as the tourist spot and has enjoyed a good average growth from 5.56 million tourist arrivals in 1998 to 25.03 million tourists in 2012 (<http://corporate.tourism.gov.my>). The income from the tourism industry has also increased tremendously (67.1%) between the year of 2006-2009, which is worth of RM53.4 billion (Malaysia Tenth Plan).

In Malaysia, the most popular form of tourism is ecotourism. Ecotourism in marine parks can be defined as marine ecotourism, which means ecotourism that takes place in coastal and marine settings (Mike, 1999). Besides that, ecotourism is becoming the fastest growing form of tourism in Malaysia, currently making up about 10% of the country's tourism revenue (Badaruddin, 2000).

Marine Parks are one of main attractions of ecotourism in Malaysia. Since year the 2002 until 2012, Marine Parks in Malaysia have received about 6.6 million tourists. The tourists from local contribute about 56% while remaining 44% are

international tourists (<http://www.dmpm.nre.gov.my>). It is among the highest natural places visited by tourists. Thus, marine parks have become a national priority that has been gazetted as Marine Park under the Fisheries Act 1985 (Amended 1991) in 1994. Marine Park includes islands having the most significant areas for marine biodiversity in Malaysia. Under this act, 42 Marine Parks in Malaysia have been gazetted.

The main objective for gazetting the parks is to ensure the sustainability of the Marine Parks. Malaysia's islands have marine lives that make them a real pull for divers around the world. To maintain these marine lives and to ensure their sustainability, these Marine Parks, which have become "the haven" for the diverse and abundant fragile marine lives, need to be properly managed.

However, these Marine lives are now under threat from these flourishing tourism business and poor management of the Marine Parks, that is happening around the globe. Foley et al. (2010) stressed that the declining health of marine ecosystem around the world is evident because the current piecemeal type of governance is inadequate to successfully support healthy and sustainable ocean and marine parks.

Lozano et al. (2009) suggested that proper zoning can help protect the marine lives and improve the management of the protected marine parks. Zoning is a spatial planning tool that acts like a town-planning scheme, which provides area-based controls and separates conflicting uses (Day, 2002). Lozano et al. defined zoning as a technical planning instrument, which can be used to establish Natural Protected Areas (NPA). The NPA allows the territories to be organized in terms of their conservation and their representativeness of their ecosystems, while taking into

account the natural vocation of the land and its current and potential use, in conformity with the objectives outlined in this declaration.

In addition, Douvère (2008) noted that zoning is effective in addressing the sustainability of Marine Parks. Zoning partitions a region into zones that are designed to allow or prohibit certain activities, to maintain the provision of an overall set of ecosystem services provided by the overall zoned area (Halpern et al., 2008). This technique allows a protected marine area to be based on its ecosystem features (Lozano et al., 2009). Zoning has long been regarded as a cornerstone in Marine Park management, separating conflicting uses through application of the various zones and determining the appropriateness of various activities (Day, 2002).

Day (2008) also outlined three benefits such as reduced risk of marine activities from damaging the marine ecosystems, more efficient use of available marine space and resources, and an effective and holistic tool to achieve sustainable development of Marine parks. Examples in which this approach has been adopted include the Great Barrier Reef Marine Park in Australia (Whitehouse, 1993; Day, 2002), marine parks and reserves in South East Asia (White & Courtney, 2002), Socotra Archipelago in Yemen (Klaus et al., 2003) the Florida Keys National Marine Sanctuary in the United States (Suman et al., 1999), and Lundy Island Marine Nature reserve in the United Kingdom (Laffoley, 1995).

1.2 Problem Statement

The past twenty years have observed a significant acceleration in the decline of marine ecosystems throughout the world with concurrent loss of biodiversity, species richness, and structural complexity (Robert et al., 2002). Resources for

conservation measures, especially among developing nations are often seriously lacking, making affective management of protected areas well beyond their means (Bellwood et al, 2004). Nearly a thousand marine parks or marine protected areas cover over 98,000 km square or 18.7% of the world's coral reef habitats. However, only less than 9% was effectively managed (Howard et al, 2009). Day (2008) stressed that effective management is a key aspect of managing any marine area. He also stresses the importance of zoning as an effective way for maintaining a sustainable marine park.

In the case of Marine Park, Malaysia too shares the same dilemma faced by the world. The success rate of the marine park has become a big question. The high number of tourist visiting the islands everyday does not satisfy people over the damage on the environment beauty, the corals, reef, and water pollution. *The New Straits Times*, on 12 September 2002 highlighted the worsening condition of Marine Parks in Malaysia. The newspaper also discussed about the degradation of the marine lives quality and the loss of marine habitats.

One of the contributors to this problem is the lack of a proper process for zoning plan for the marine parks in Malaysia. This statement has been supported by Lim (1998), Badaruddin (2002), and UNDP (2001). The conflicting activities carried out in the Marine Parks are threatening their marine lives and their sustainability.

Badaruddin (2002) has stressed the seriousness of the damage done on the case of Marine Parks in Malaysia. He articulated that the Marine Parks in Malaysia now face a major threat of losing their biodiversity due to mismanagement. Lim (1998) also stressed the need for a proper zoning to facilitate the implementation of a sustainable Marine Park Management in Malaysia. UNDP's (2001) report on the

marine parks in Malaysia has suggested the need and importance of proper zoning plan for sustainable marine parks in Malaysia.

The result of weak zoning and management system has resulted in major closures of famous Marine Parks around Malaysia. Nine famous diving locations involving six Marine Parks have been closed from 2 July 2010 till 31 October 2010, due to the serious coral bleaching (Department of Marine Park, 2010). The Marine Parks that have been closed are as follows:

- Pulau Payar, Kedah: Teluk Wangi, Pantai Damai, and Coral Garden;
- Pulau Perhentian, Terengganu: Teluk Dalam, Pulau Perhentian Besar, Tanjung Tukas Darat, and Tanjung Tukas Laut;
- Pulau Redang, Terengganu: Teluk Bakau, Pulau Tenggol, Teluk Air Tawar;
- Tioman Island, Pahang: Pulau Chebeh and Batu Malang;

The closure of the Marine Parks indicated that the health of these marine parks has reached a critical condition and a proper action need to be taken immediately to avoid further destruction to the marine park and its lives. Many local and international researchers have recommended that a good and sustainable management system of the Marine Parks to be implemented through a proper zoning process.

Literature review shows that there are mainly four Marine Park zoning process found on this subject, as those proposed by Day (2008), Douvere (2008), Gilliland and Laffoley (2008), and Day et al. (2008). The literature review also

shows that very limited study has been done on the zoning of the Marine Parks in Malaysia.

1.3 Research Objectives

Zoning has been implemented and applied throughout the globe, as a management tool for various developments including marine parks over the last 30 years (Day, 2008). Thus, this study aims to focus on zoning as a tool for developing a sustainable marine park in Malaysia. The study will look into the current practice of Marine Park zoning process in Malaysia and will propose a proper zoning process towards maintaining a sustainable marine park, based on the best-practice that has been implemented around the globe.

More specifically, the objectives of this study as follows:

1. To evaluate the current policy and practice of marine park zoning process in Tioman Island; and
2. To propose a proper marine park zoning process towards implementing a sustainable marine park management system in Tioman Island.

1.4 Research Questions

To achieve the research objectives, the study will attempt to answer the following research questions.

1. What are the current policies and practices of Marine Park zoning process in Tioman Island?

2. What is the best approach of zoning process to be implemented to maintain a sustainable marine park management system for Tioman Island?

1.5 Outline of Research Methodology

This study has adopted the qualitative research method which is described in further detail in Chapter 4.

1.6 Scope of Research

The scope of this research covers the best available data on the zoning process of the Marine Park in Malaysia. Data will be limited to include those available from the Department of Marine Park, Local Authorities, and Department of Town and Country Planning of Peninsular Malaysia. In addition, this research will only focus its study on the island of Tioman Island in Malaysia.

1.7 Definition of Key Terms

There are few key terms used in this research which are zoning and Marine Park. In Malaysia zoning is widely used for the planning scheme; zoning helps to control and avoid conflicts in the development of the system. In this study, the definition of zoning is adopted from Marine Bill White Paper (2007). The Bill defined zoning as

... a means to create and establish a more rational organization of the use of marine space and the interactions between its uses, to balance demands for development with the need to protect the environment in planned way. (Marine Bill White Paper, 2007)

According to the Fisheries Act, 1985, under Part IX – Marine Parks and Marine Reserves (Sections 41-45), Marine Park is defined as “... the limit of any area or part of an area established as a marine park shall be at a distance of two nautical miles seaward from the outermost points of the islands specified.” There are 38 gazetted Marine Parks in Malaysia, which are developed and supervised by both the Federal and the State Governments. The States have legislative control over the land and seabed up to a limit of 3 km offshore, while the maritime waters are under Federal control. However, zoning for Marine Parks actually lies with the State authorities.

The zoning process for the Marine Parks is currently included in reports prepared for the development of islands such as the Tioman Island Carrying Capacity and Development Guidelines Report for Tioman Island (2006), Marine Park Island Management Conceptual Plan for Peninsular Malaysia (1994), and Master Plan of Tioman Island 2020 (1995). These reports were not initially prepared for zoning purposes, but for the development and management of Tioman Island. However, in general the concept of zoning has been indicated and incorporated in the report.

1.8 Outline of Thesis

This thesis is divided into seven chapters. A brief overview of each of the chapters is outlined in Figure 1.1. Chapter 1 touches briefly on the background of the research, the objectives, and purpose of the research. Chapter 2 discusses the management of marine parks in Malaysia. Chapter 3 reviews available literature on zoning as a tool for a sustainable management of marine parks. The chapter also looks at the management of marine parks that has been practiced around the globe in relation to the application of zoning in marine park management. Chapter 4 provides

details on the design of the study, the procedure used for data collection, and the types of analyses employed in this study. Chapter 5 presents the results of data analysis and the main findings of the study from the personally administered survey questionnaires and in-depth interviews. Then, Chapter 6 is gives a discussion based on the results, findings, and literature reviewed. Finally, Chapter 7 highlights the summary and recommendations for future research.

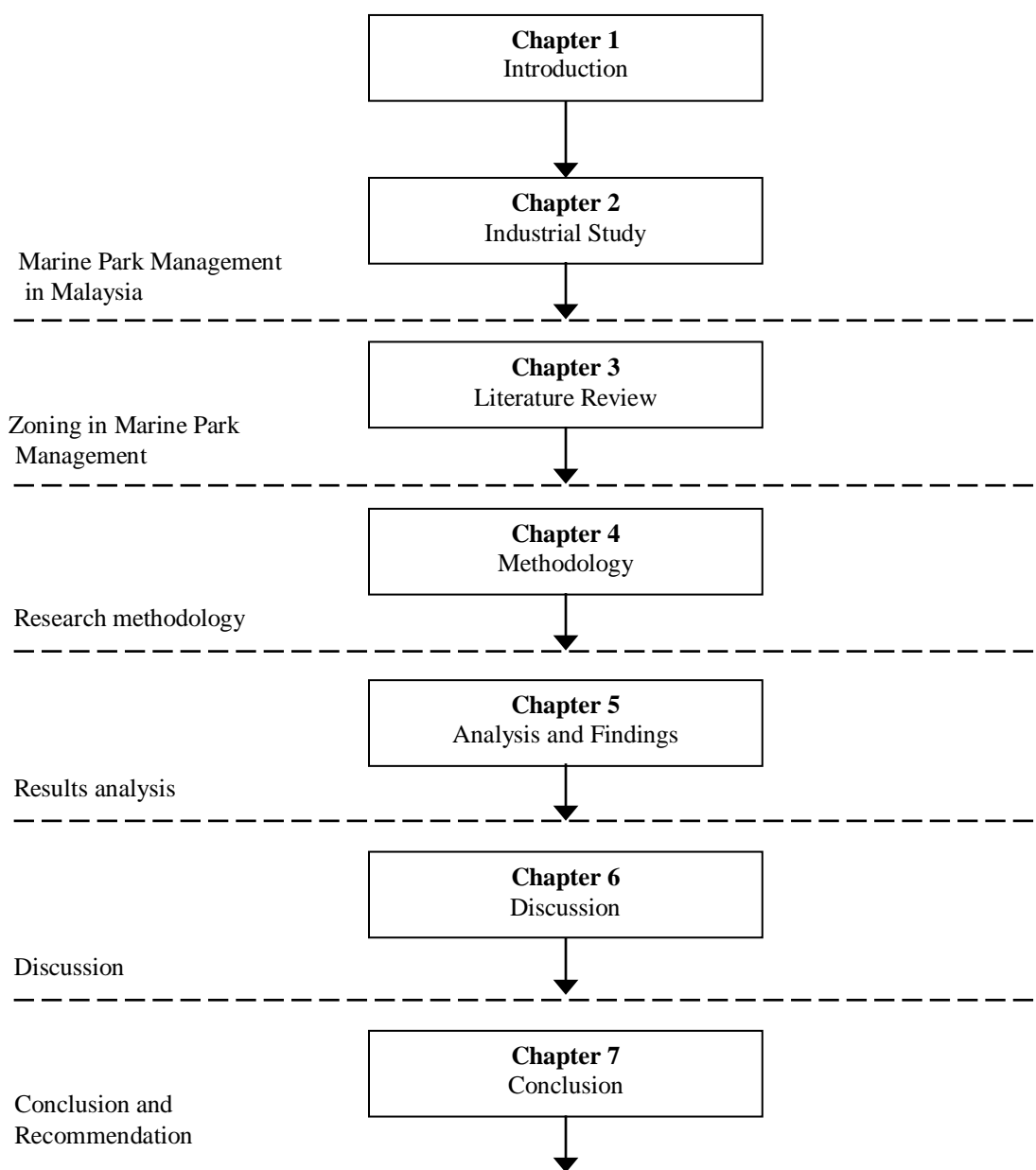


Figure 1.1. Structure of the study

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the zoning practices in Marine Park Management. The chapter will elaborate on the Definition of Zoning, Zoning Theory and Principles, Zoning Process, and a study case implementing Zoning in the Marine Park Management.

2.2 Zoning: Background and Definition

Zoning was originally used for town planning scheme. The technique can be traced back to the 1920's, when it has been implemented in American cities (Gans, 1969). Gans (1969) mentioned that Zoning functions as development control tool and avoids land uses in cities. Zoning has grown over the decades to become a vital and positive tool for the guiding of city and community development. Johnston (1969) also agreed to this and put forward zoning as the most comprehensive and effective device available to carry out public control of land use.

Zoning started from town planning scheme, and now it has been applied to biosphere reserves, parklands, fisheries, and Marine Protected Areas (Portman, 2007). Zoning has been recognized as an effective tool to address the sustainability of Marine Park (Douvere, 2008) and it has been effective in addressing the conflicts of use in Marine Parks (Stephen et al., 2006).

Zoning has been recognized as the means to address the sustainability and ecosystem-based management approach of Marine Parks (Douvere, 2008). It is also

effective in addressing the conflicts of use in Marine Parks (Stephen et al., 2006). Zoning ensures an overriding conservation rationale for the entire area, minimizing impacts and conflicts and provides for high levels of protection for specific representative areas, while allowing a variety of other uses to continue in other zones (Day, 2008). Zoning has been used widely around the world as a management tool for a sustainable Marine Park (Foley et al., 2010).

Zoning plans was built on a combination of social and environmental information, and now it has been developed for many marine protected areas (MPAs) worldwide (Day, 2002). Douvère (2008) stressed that this because of its importance in establishing ecosystem-based management in marine environments. Furthermore, the .Zoning schemes provide a method for defining the purpose for which an area may be used (Kelleher & Kenchington, 1992). The level of use restricted within defined spaces or zones are represented in a zoning plan, which is published in map form.

For this study, zoning can be defined in two views. First, it can be defined from the perspective of town planning (Chapin & Kaiser, 1979; Gans, 1969; Holden, 2000; Johnston, 1969). Second, it can be defined in the perspective of marine park management (Douvère, 2008; Foley et al., 2010; Lozano et al., 2009; Marine Bill White Paper, 2007; Portman, 2007).

In the earlier era, zoning was mainly used for town planning of a state or district. Zoning divides community into districts and zones and it regulates within such districts the use of land, heights, and area of buildings (Gans, 1969).

Meanwhile, Johnston (1969) looked at zoning as an established land management strategy that aims to integrate tourism into environments by defining areas of land that have differing suitabilities or capacities for tourism. Hence zoning of land may be used to exclude tourists from primary conservation areas, and to focus environmentally abrasive activities into locations that have been specially prepared for such events. In other words, it may be used to bring general visitors to focus into a limited number of locations where their needs may be met, while their impacts controlled and managed. Chapin and Kaiser (1979) states that in land use, zoning land is resource and land use means resource use.

Holden (2000) views zoning as a land management strategy that can be applied on different spatial scales, for instance within a protected area, or at a regional and even national level. Zoning also can provide a proper recognition of the resources that exist in the area and subsequently identify where tourism can and cannot take place.

The definition of zoning in town planning can be concluded as the means for the city planning to divide the cities with regulations to control the development and avoid the conflict of land uses. However, Holden (2000) suggests the effective use of zoning into other areas such as for protected areas. Douvere (2008) found that zoning in Marine Park Management has evolved over the years in Marine Park Management and also known as Marine Spatial Planning (MSP). However, throughout this study zoning will be used as the term as the concept MSP is widely used in all the references. The adaptation of zoning in Marine Park has been significantly highlighted by the Portman (2007), in realizing the importance and effectiveness of

the zoning. Therefore, it has been adopted in biosphere reserves, parklands, fisheries, and Marine Protected Areas.

The definition of zoning in Marine Park management was given mainly by four researchers, namely Marine Bill White Paper (2007); Douvere (2008); Lozano et al. (2009), and Foley et al. (2010).

Marine Bill White Paper (2007) states that zoning in Marine Park Management functions to create and establish a more rational organization on the use of marine space and the interactions between its uses, to balance demands for development with the need to protect the environment in planned way.

While Douvere (2008) defines zoning as a strategic and integrated plan-based approach for marine management that makes it possible to look at the “bigger picture” and to manage current and potential conflicting uses, the cumulative effects of human activities, and marine protection

Lozano et al., 2009 view zoning as a technical planning instrument which can be used to establish Natural Protected Areas (NPA). Zoning allows for organizing territory in terms of its conservation and the representativeness of its ecosystems, taking into account the natural vocation of the land and its current and potential use, in conformity with the objectives outlined in this declaration.

In addition, Foley et al. (2010) define zoning as a process that addresses the spatial distribution of activities in the ocean so that the existing and emerging uses can be maintained, the conflicts in use can be reduced, and the health and services of the ecosystem can be protected and sustained for future generations.

From the definitions of zoning in Marine Park Management by the researchers it can be concluded that zoning is a process that deals with the allocation of activities spatially to avoid conflicts between human uses and natural preservation. Zoning of Marine Park Management also functions to avoid the impacts of the human activities to the marine lives, and finally zoning ensures the sustainability of the marine biodiversity.

2.3 Zoning in Marine Park Management

Zoning is regarded as a comprehensive ocean zoning system that has been used as a management tool over the last 30 years (Day, 2008). Day (2008) further explains that zoning aims to ensure the wide range of marine activities is ecologically sustainable and to ensure an overriding conservation rationale for the entire area to minimize the impacts and conflicts, and to provide high levels of protection for specific representative areas, while allowing a variety of other uses to continue in other zones.

Newsome et al. (2002), also suggest that zoning is a key management strategy in marine planning in which activities are separated by either space and or time. Chapin and Kaiser (1979) also stress that the zoning or land use planning must also plan for advance planning and action planning activities.

The Zoning of Marine Parks is a viable and effective management procedure, whereby different zones within a Park define what uses are limited, to what extent, and by what means (White, 1998). Douvere (2008) also stresses that the evolution of Zoning and ocean zoning has become a crucial step in making ecosystem-based, sea-use management a reality.

Zoning is especially effective for multiuse areas like Marine Parks and is a recommended Ecotourism guideline for Marine Parks, as stated in the National Ecotourism Plan (WWF Malaysia, 1996).

Zoning has been recognized as a means to address sustainability and ecosystem-based management approach of the Marine Park (Douvere, 2008). Ehler et al. (2007) adds that zoning can influence where and when human activities occur in marine spaces.

Zoning also ensures an overriding conservation rationale for the entire area, minimizing impacts and conflicts and provides for high levels of protection for specific representative areas, while allowing a variety of other uses to continue in other zones (Day, 2008).

Douvere (2008) suggests that zoning is an effective process as it

- (a) Addresses the heterogeneity of marine ecosystems in a practical manner;
- (b) Focuses on influencing the behavior of humans and their activities over time;
- (c) Provides a management framework for new and previously inaccessible scientific information;
- (d) Makes conflicts and compatibilities among human uses visible; and
- (e) Guides single-sector management towards integrative decision making.

More concretely, the Maritime Policy of The European Union (2005) depicts zoning as a means to:

- (a) Manage the competition among various uses and objectives of the marine environment;
- (b) Coordinate the spatial implementation of offshore renewable energy with other activities;
- (c) Provide financial security for investment decisions;
- (d) Develop a stable regulatory environment that ensures better and simpler regulation toward the location of economic activity;
- (e) Ensure consistency between land and marine systems; and
- (f) Ensure that the future development of offshore activities is consistent with the need to evolve multilateral rules.

There are many countries have adopted the zoning in marine management plans such as Australia, USA, Canada, China, UK and many others. Douvère (2008) has found that during the last decade, zoning and Marine Spatial Planning has gained considerable importance in establishing ecosystem-based management in the marine environment.

Several countries have started implementing zoning or spatial planning of their Marine Parks. The countries includes the United Kingdom in a part of the Irish Sea, Belgium in a part of the North Sea, the sea areas of China, Canada's Eastern Scotian Shelf, the high seas, Australia's Great Barrier Reef Marine Park and within USA, the coastal waters of Massachusetts, Rhode Island and North Carolina (Foley et al., 2010). Zoning practice for Marine Park in other countries can be summarized in the Table 2.1.

Table 2.1
Zoning Practices in Other Countries

Country	Initiative	Year
Australia	Great Barrier Reef Marine Park Zoning and Re-Zoning	1978-2005
USA	Marine Bioregional Planning	2002 - ongoing
	Florida Keys National Marine Sanctuary and Tortugas Ecological Reserve; Channel Islands National Marine Sanctuary	1990 - 2001
NL-DE-DK	Trilateral Wadden Sea Plan	1993-2010
Canada	Large Oceans Management e.g., Eastern Scotian Shelf Integrated Management	1998-2007
China	Marine Functional Zoning of Terrestrial Sea	2002 - ongoing
UK	Irish Sea Pilot Project	2002-2005
Belgium	Master Plan for the Belgian part of the North Sea	2003-2005
The Netherlands	Integrated Management Plan for North Sea 2015	2003-ongoing
Germany	Spatial Plan for North Sea and Baltic Sea	2004-ongoing
Norway	Integrated Management Plan for Barents Sea	2005-2006

Note. Taken from Foley et al. (2010)

2.4 Types of Zoning

According to Day (2008), many types of zoning have been proposed in Marine Parks. For example, the Great Barrier Reef Section of Australia (GBR) is divided into the zones described in Figure 2.1 and Table 2.2 and zoned as follows:

- (a) Preservation Zone
- (b) Marine Natural Park Zone
- (c) Science Research Zone
- (d) Buffer Zone
- (e) Conservation Park Zone
- (f) Habitat Protection Zone
- (g) General Use Zone

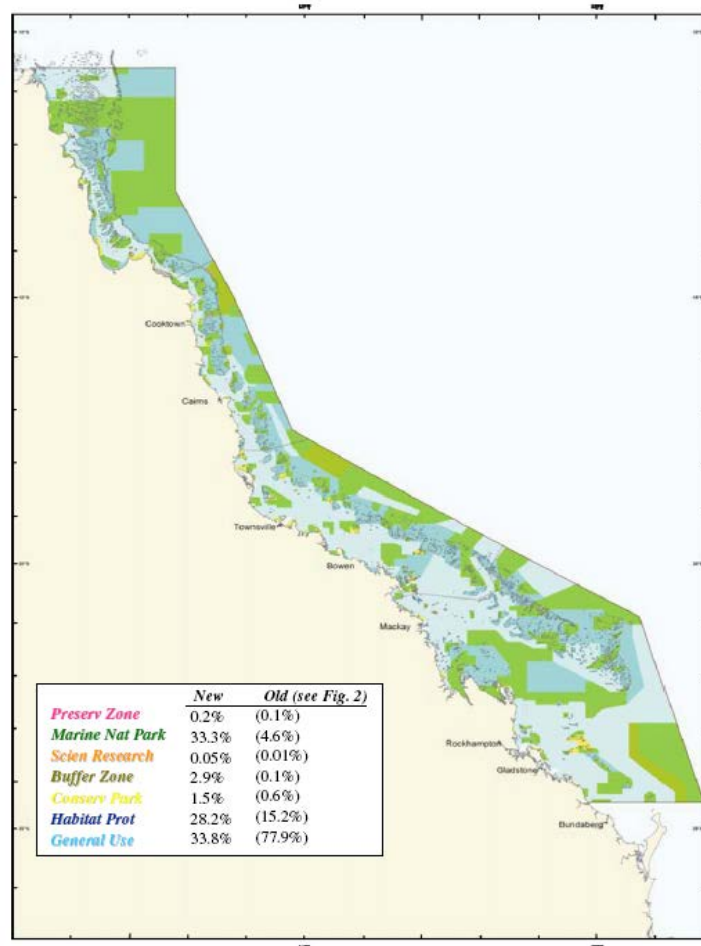


Figure 2.1. Map showing zoning in the GBR. Taken from Great Barrier Reef Marine Park Authority, Australia.

Table 2.2
Outline of Zoning Provisions in the Great Barrier Reef

No.	Zone	Function
1.	General Use Zone	Least restrictive of all the zones; it provides for all reasonable uses, including shipping and trawling. Prohibited activities include mining, oil drilling, commercial spear fishing and spear fishing with SCUBA.
2.	Habitat Protection Zone	Provides for all reasonable uses, including most commercial and recreational activities. Shipping and trawling are prohibited as well as those activities not allowed in General Use 'A' Zone.
3.	Conservation Park Zone	Provides for appreciation and recreational use, including limited line fishing (one line/hook per person). Spear fishing and collecting are prohibited as well as those activities not allowed in General Use 'B' Zone.
4.	Buffer Zone	Similar to an adjacent to MNP 'B' zones, but allows pelagic trolling. All those activities not allowed in Marine National Park 'A' Zone are also prohibited.
5.	National Park Zone	Provides for appreciation and enjoyment of areas in their relatively undisturbed state. It is a 'look but don't take' zone, in which all forms of extraction (including fishing) are prohibited.
6.	Scientific Research Zone	Set aside exclusively for scientific research; entry and use for other reasons is prohibited.
7.	Preservation Zone	Provides for preservation in an undisturbed state. All entry is prohibited, except in an emergency, with the exception of permitted scientific research which cannot be conducted elsewhere.

Note. Adapted from Great Barrier Reef Marine Park Authority, Australia

Another example of zoning is that of Canadian Parks Service which has zoned the park into five zones as follows:

- Zone 1: special preservation – areas that contain strictly protected, rare, or endangered species and where access is strictly controlled;
- Zone 2: wilderness – represents 60% to 90% of the park area and the primary aim is resource preservation. Use is dispersed, and facilities are limited;
- Zone 3: natural environment – this area acts as a buffer zone between zone 2 and zone 4, and access is primarily nonmotorized;

Zone 4: recreation – overnight facilities such as campsites are concentrated in this area; and

Zone 5: park services – this area is highly modified to provide many services, but represents less than 1% of the park area.

2.5 Principles of Zoning

The principles of zoning can be adopted from Marxan software used for Conservation Zoning and for Marine Park. Marxan is the most widely used conservation planning software in the world and is designed for solving complex conservation planning problems in landscapes and seascapes (Watts et al., 2009).

This principle has been used as the guidance in Zoning Process for the Marine Park Zoning. There are five guiding principles in zoning. These principles are important during the zoning process, which will be discussed in a later chapter. The key principles of reserve design are as follows:

2.5.1 Efficiency

The first principle of Zoning is efficiency. Efficiency describes the ability of a reserve design process to represent biodiversity objectives at least cost. Because resources available to achieve conservation goals are finite, inefficient systems are less likely to achieve the goals. By planning and zoning reserve systems efficiently, it minimizes the risk of reaching the ceiling on the amount of resources available before all biodiversity objectives are met. Limiting resources or limiting factors are described as "costs."

Factors limiting the efficiency of a reserve are the following:

- the area available for reservation
- the costs of ongoing management
- opportunity costs (i.e., displaced fishing effort)
- acquisition costs

Decisions about individual reserves affect the performance of the reserve system as a whole. Therefore, Efficiency is also concerned with the way sites are prioritized for reservation. The most efficient solutions are obtained by selecting sites as a complementary set.

2.5.2 Complementarity

Second principle is the reserve sites should be selected as a complementary set, where each one complements the features of other sites. Sites complement each other well if they contain quite different biodiversity; consequently their selection provides a combination of sites that achieve the goal of comprehensiveness in the most efficient way.

The principle of complementarity means that planning and zoning for reserve systems is best informed by what is already contained within the existing reserves - an exercise referred to as gap analysis. Site selection proceeds by iteratively reviewing how well the existing targets are achieved when individual sites are added to or removed from the reserve system. This process identifies a system of sites that contribute most efficiently to the unmet conservation targets.

2.5.3 Comprehensiveness

Comprehensiveness is the third principle. It requires reserve systems to sample the full range of biodiversity (both typical and atypical), taking into consideration biodiversity composition, structure and function and evolutionary processes. A reserve system is most comprehensive if it contains examples of as many elements of biodiversity as possible.

2.5.4 Adequacy

The fourth key principle is adequacy. Well designed systems of individual reserves are considered to be superior to isolated individual reserves, as they can provide meaningful spatial relationships amongst sites for the maintenance of ecosystems and connectivity, and offset the effects of local catastrophes. A system-based approach to reserve design, where the whole is more than the sum of its parts, recognizes the relationship between individual reserves, and therefore the role of each reserve as part of an interactive system. One general strategy that has been proposed to address the issue of persistence in the absence of detailed knowledge is the notion of replication (making sure that one does not have all of one feature in one place). Replication improves the likelihood of regional persistence, spreading the risk of failure by providing greater opportunity for recolonization from other viable and connected areas.

2.5.5 Representativeness

The last principle is representativeness. It requires reserve systems to capture biodiversity that is representative of their surroundings. For example, if one wishes to protect populations of a particular species or samples of a habitat, it is best if the

samples chosen cover the range of variation in that species and/or habitat. Wherever possible, the selection of such typical areas should take into consideration any communities/species that are rare, endangered or considered to be unique, distinct or atypical. Considering the level of selection frequency is a useful way to think about prioritization. Sites with high selection frequency are likely to be a high priority in achieving the reserve system goals, as high irreplaceability means high priority.

2.6 Zoning Process

There are four researchers who have put forward their approaches for zoning process and steps for Marine Park management. They are from Douvère (2008), Day et al. (2003), Gilliland and Laffoley (2008) and Day et al. (2008). The first three researchers looked at the macro level of the zoning process, while Day et al. (2008) looked in the micro level of the process, providing the detail steps of zoning process focused on the zoning plan for the Marine Park.

2.6.1 Zoning Process by Douvère (2008)

Douvère (2008) suggests that to be effective, zoning of Marine Park needs to be conducted as a continuous, iterative, and adaptive process, and this consists of three ongoing phases, such as the following.

(a) Planning and Analysis

Planning means generating and adopting one or more integrated, comprehensive spatial plans for the protection, enhancement and sustainable use and development of the sea and its resources (Douvère, 2008). The planning and analysis phase will be based on a set of research initiatives including mapping, that addresses

both environmental and human processes (Crowder & Norse, 2008; Martin & Hall-Arber, 2008).

Day et al. (2003) suggest the development of the bioregionalisation map is important in planning stage for the zoning plan. A comprehensive range of biodiversity and physical information must be prepared. The map showing this information must be prepared with marked information about the marine biodiversity.

(b) Implementation

This phase involves implementing the plan through the execution of programmed works or investments, that enables change. The improvement could be encouraged through regulation and incentives, or through the enforcement of the proposed changes on the ongoing activities. The enforcement could cover activities in, on, over, or under the sea, such that they are in accordance with the proposed plans (Maes & Plasman, 2008).

Day et al. (2003) argue that the development of clear and transparent operating principles must be adhered to in the implementation of the Zoning Plan. Scientific Steering Committee consisting of expert panels from Marine Scientist and Reef Experts must be set-up to advise the management of the Marine Parks.

Day et al. (2003) also stress the importance of the public consultation. The draft Zoning Plan must be publicized to the public before it is gazetted and implemented.