

# A Mini Review on the Present Status of the Marine Fisheries in Sabah, Malaysia

## Abstract

Sabah, which is located at northern part of Borneo Island, is well-known to be one of the states in Malaysia that has vastly coastline and fishing ground. Thus, the state play significant role in the development of marine fisheries sector in Malaysia. The implementation of Exclusive Economic Zone (EEZ) and Sulu-Sulawesi Marine Eco-region (SSME) by national government had emulated the state in enhancing the development of fisheries management. Therefore, some important information about biological, sociological and economical dimension of fisheries in Sabah had been highlighted and discussed. Hence, various types of marine fisheries studies and data collection had been done in Sabah for quiet number of years and they proved to be helpful in understanding the exact status of marine fisheries stocks in Sabah, which are now hampered by common problems of fisheries management such as over-fishing and the destruction of fish habitat.

**Keywords:** Sabah; Marine fisheries; Studies; Development; Over-fishing

## Mini Review

Volume 2 Issue 4 - 2015

### Mohd Azim Bin Mohd Khatib\*

*Department of Aquaculture, Universiti Putra Malaysia, Malaysia*

**\*Corresponding author:** Mohd Azim bin Mohd Khatib, Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia, Tel: +60199847392; Email: azmm\_1988@yahoo.com.my

**Received:** January 26, 2015 | **Published:** August 25, 2015

**Abbreviations:** EEZ: Exclusive Economic Zone; SSME: Sulu-Sulawesi Marine Eco-Region; DOF: Department of Fisheries; CPUE: Catch-Per-Unit-of-Effort; EE: Ecotrophic Efficiency; UPM: Universiti Putra Malaysia

## Introduction

Fisheries sector in Malaysia play essential role in socio-economic and social development as this country is one of countries in South-east Asia that is blessed with vastly coastline. Fishing grounds in coastal area of Malaysia were extended beyond old area where the total area nowadays is about 548,800 km<sup>2</sup> under the implementation of Malaysian Exclusive Economic Zone (EEZ) which was enforced in 1981 [1]. The EEZ implementation in this country had proved to emulate and enhancing development of the nation through vacancy of employment, fish export (transaction of foreign exchange) and one that is most important is to supply enough food for growing population of people [2]. The Department of Fisheries (DOF) of Malaysia expected the growth of at least 5% annually (investment) of fisheries sub-sector and the department also estimated by the year of 2010, which is the final year of Third National Agriculture Policy, the total national fish production will be worth RM9.36 billion with 1.93 million metric tonnes in total weight [3].

Generally, the current situation of fisheries sector in Malaysia is keep changing according to time and world condition. As for now, the fisheries world is facing several issues especially regarding over-exploited of fisheries resources. In Malaysia, a few numbers of problematic issues had surfaced such as license limitation, allocation of fishing grounds, mesh size regulation

policies and most importantly inequalities in term of socio-economic difference between the two majority races that dominated fishery industry in Malaysia; the Malay people are predominantly involved in artisanal fishery while the Chinese are majored in commercialized fishery [4]. Furthermore, the uncontrolled usage and growth of trawl fishery in the early 1970s was severely damaged a lot of fish habitat in the Malaysian inshore waters, thus, significantly reduced the fishery production [5].

Geographically, the state of Sabah is located at the northern part of Borneo Island (Figure 1). The state is well known for its large area which is estimated about 74,236 km<sup>2</sup> and its total length of coastline, including islands and lagoons is about 4,315 km, thus making it the state in Malaysia with the longest coastline [6]. Furthermore, the state enjoy high rate of growth in fisheries sector although tourism industry is the main sector in driving the economic growth of the state [7]. Basically, there are 3 main fishing grounds (zones) in Sabah, comprise of West coast region, Kudat coast region and East coast region [8]. So, it is very important to have critical and comprehensive shoreline or coastline management policies and plan in order to maintain and preserve fish stocks in those zones. The aim of this paper is to review the status of marine fisheries in Sabah with focus on the dimension of fisheries, data collection as well as issues of marine fisheries in this state.

## The dimension of fisheries

The fish stocks of Sabah are basically comprised of pelagic and demersal fishes with various types according to their habitat such as coastal crustaceans, coastal demersal fish, offshore demersal fish, coral reef fish, offshore small pelagic fish and tuna

[8]. Hence, recent studies and observation from many parties had indicated and identified that there are about a hundred species of commercial value marine fishes in water bodies of Sabah [5,9-11]. Therefore, Sabah actually is blessed with the abundance of suitable coastal places such as coral reefs, mangrove swamps, and sea grass beds which are perfect for fish breeding site [2]. However, the over-fishing of reef fishes and the use of dangerous fishing gears in Sabah had caused the significant declining in catch rate of fish [4].

Sabah is infamously known for its highly diversified multi-racial population. The last population and housing census of Sabah which was conducted in 2010 showed that the total population is 3,117,405 with about officially 30 recognized indigenous ethnic groups [12]. In fisheries sector, about 75% of the population work and live in the coastal zone, mainly at the coastal area of Kota Kinabalu, Sandakan, Tawau, Lahad Datu and Semporna [13]. Their jobs are ranged from subsistence fishermen, commercialized fishermen, fish traders and other jobs that are related to fisheries industry. Unfortunately, large

portions of illegal immigrants, mainly from Indonesia and Philippines had resided in many coastal area of Sabah for quite number of years [3]. Consequently, the conflict between them and the local people had ensued many times as they tried to indiscriminately dominate the fisheries sector over there.

In Sabah, fisheries are categorized in agriculture section, together with live stock rearing and crop planting [14]. Averagely, about 2% of the state's annual Gross Domestic Product were come fisheries sector [2]. A total of about 20,000 persons had been involved directly in fisheries sector of Sabah, commonly as full-time fishermen with 30% of them are known as commercialized operators and the rest of them are artisan or small scale operators [15]. Hence, the implementation of Exclusive Economic Zone (EEZ) by the federal government of Malaysia and the enforcement of Sulu-Sulawesi Marine Ecoregion (SSME) by the state government of Sabah had improved the performance of fisheries sector in boosting the state's economy [14,16,17].

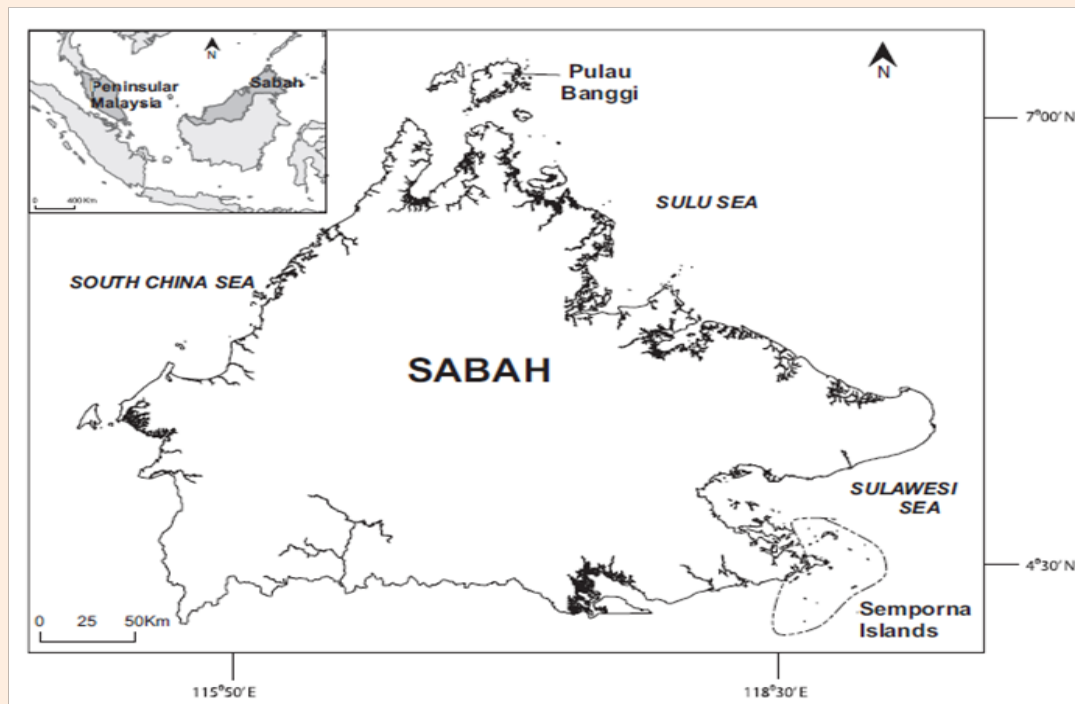


Figure 1: Map of Sabah state [31]. The inset map shows Malaysia in shaded gray.

### The types of marine fisheries

At present fishing activities in the state are concentrated with the 30 nautical mile limit and thus Sabah's fisheries may be termed as predominantly coastal [10,18]. The number of full-time fishermen in Sabah employed in the marine capture fisheries industry in Sabah is about 20,000 persons<sup>2</sup> [19]. Of these, commercial operators number about 30% while the rest are artisan fishermen and small-scale operators. The number of part-time fishermen is unknown. The top 5 most populous areas

are Semporna, Sandakan-Beluran, Tawau, Kota Kinabalu and Tuaran [6,13,20,21]. The top five fishing gears by predominance are as follows: trawls, gill-drift nets, hooked gears, lift nets (bagang and selambau), and seine nets (including purse seines) [9,15,17]. These gear statistics are based on licenses issued. It is estimated that there are many unlicensed gears of the traditional types such as rambat, bubu, hook and line and near-shore gill nets currently being operated [9,17]. Generally, the main yield of fish production mainly comes from fish production from deep sea fisheries, coastal fisheries and marine aquaculture.

Deep sea fisheries have seen major developments in the last few years. Although before this there have been fishing activities beyond the 30 nautical mile-limit, these have been using mainly traditional gears (especially hooked gears) which are inefficient and of low economic viability and thus not considered as true deep sea fishing operations [3,12,13,16]. Most of the deep sea fishing is carried out by purse seiners. Most of the deep sea fishing vessels actually operates not far from 30 nautical mile limit although the true deep sea fishing vessels are those that can operate far out in the 200-mile EEZ [17]. The main types of fish landed are the shoaling pelagic [10,15]. Deep sea fish production accounted for about 30% of the total fish landings in Sabah [2]. For coastal fisheries, trawling continues to be the mainstay activity [10,13,15,17,21]. Although finfish trawl fisheries is significant, in terms of value, the prawn fisheries is a large contributor [6]. Most of prawn productions were exported to many countries in Asia and Europe. The bulk of the commercial landings were mainly contributed by trawlers, bottom gillnets and purse seiners [13,21]. On the other hand, Landings from traditional gears were mainly contributed by hook & line, "bagang" (static liftnet) and "selambau" (active liftnet) [21].

Marine aquaculture is a nascent industry in Sabah. In terms of operation scale, small farm predominate which are practiced more on a subsistence level [6,8,9]. Only a few farms of medium scale operations can be considered to be commercially oriented in practice. The main contribution to this fisheries comes from prawn farming, seaweed mariculture and cockle exploitation. At present the main activity of marine aquaculture in Sabah is still the culture of prawn and fish in brackish water ponds [3,15]. The most extensive areas are found in Tawau, Sandakan, Kota Belud and Kota Kinabalu-Tuaran. The next important aquaculture activity is the culture of marine fish in cages [6]. A number of these operations are not true cage culture as they do not rear the fish from young but rather employ these cages as holding facilities for market-size fishes caught from the wild (for a few months) while waiting for export to foreign live fish markets as well as for sale in the domestic markets. Most of these fish are high-value species [6,16,19]. Seaweed mariculture has gained prominence as a viable aquaculture enterprise in the last few years [18]. Cockle, mussel, oyster and crab culture make up the rest of the marine aquaculture activities in Sabah [6,18,20].

### Analyses and researches in improving marine fisheries management

The significant of finding good and accurate data of fisheries is important in distributing precise review of fishery resources in the respective area. The data collection of fisheries, which is only commonly stored in log book or data collection sheets, had been known and discussed worldwide as important sources in producing formal publications of fisheries status in certain country, region or area [22-25]. There are actually 4 types of objectives or goals which are essential to be considered in distributing fisheries statistical data; biological, sociological, economy and social [26,27].

Academically, the raw data of fisheries are usually presented in the form of statistic and table. Hence, the data can be also interpreted and by using particular methods such as computer software and programmable calculator [28-31]. Among

numerous types of data that had been used in clarifying the status of fisheries resources, catch-per-unit-of-effort (CPUE) data is well known for the majority of fisheries researchers as reliable source in preparation of stock assessment of fish species although other factors such as fishing methods, fishing equipments, fisher behavior, management and economic factor can be sometimes influenced the stability of CPUE data [32,33].

The result from the data collection of fisheries resources generally can be perceived as first impression towards the sustainability of the fisheries resources around the world. Thus, many publications had emphasized the importance of data collection in the sustainable management of fishery [23,28,31]. The meticulous and careful process of data collection had also proved to help fisheries scientists in determining ideal ways of conserving fisheries resources. For instance, Maunder and Langley [33], in their journal entitled 'Integrating the standardization of catch-per-unit-of-effort into stock assessment models: testing a population dynamics model and using multiple data types', stated that the collection of CPUE data of fish species 'trevally' (*Pseudocaranx dentex*) had assisted them in preparing the model of population dynamic for this species.

The fisheries researchers who had done their research and development in Sabah evidently had prepared a lot of data collection for thorough analysis. A good example was came from Busing's fisheries report [2], where he distributed all sorts type of data (statistic table, pie chart, graph) which are related to numerous aspects of fisheries management in Sabah such as total fish production, fisheries potential yield, marine fish landings, records of types of fishing gears and fishing fleet and also total export-import of fish production. On the other hand, several basic input parameters, for instance, Production / Biomass ratio (P/B), Consumption / Biomass ratio (Q/B), and ecotrophic efficiency (EE) were used in constructing trophic model for Sabah's fisheries by using Ecopath software [18]. Moreover, the catch-per-unit-effort data collection from each station of research trawl survey off the west coast of Sabah in selected years showed some complexity in term of determining biomass trends, population parameters and the exploitation rates of dominant species of demersal fishes [1].

The government and non-government organization of Sabah had been faithfully taken their responsibility by using their authority and skills in distributing the general fisheries data for every year. According to Table 1 which is filled with list of general tabulated and statistical fisheries data of Sabah in certain duration of years (ICZM [13]; Abu Talib et al. [1]; DOF [34]), it can be summarized that the marine fish yield and the volume of salt water fish landed in Sabah are decreased year by year. Most of the data can be important sources in explaining to the public whether the fisheries resources in Sabah are over-exploited or vice versa. Furthermore, the data showed various pattern such as increasing, decreasing, slightly fluctuating or overly fluctuating especially when compare to the other type of data and therefore can be handy for many researchers in making further investigations in the future. Hence, clear and smart counter-measures can be achieved by respected parties once the data of fisheries resources is well and thoroughly understood (FAO [35]; FAO [36]).

**Table 1:** List of Some General Fisheries Statistical Data of Sabah, Malaysia.

Title of Statistic	Year(s)	Source
Marine Fish Production and Projection	1995 - 1999	[13]
Fisheries Exports and Projection	1995 - 1999	
Frequency distribution of CPUE (A) and log-transformed CPUE (B) from trawl surveys off the west coast	1972 - 1998	[1]
Growth, mortality and exploitation parameters of demersal species obtained off the coast	1998	
Gross Fish Production	1994 - 2013	[34]
Annual series of marine fish landing	1989 - 2013	
Landings of marine fish by districts and month	2013	
Landings of marine fish by species and month	2013	
Landings of marine fish by species and district	2013	
Landings of marine fish by species and gear group (commercial)	2013	
Landings of marine fish by species and gear group (traditional)	2013	
Imports & Exports Of Fishery Commodities	1992 - 2013	

For future research, it is imperative to make comprehensive study about the problem of toxic algal blooms (red tide) and paralytic shellfish poisoning which is an almost yearly occurrence [13]. It follows that further studies on red tide such as the detection of toxins and the environmental factors which promote toxic algal blooms as well as calibration studies, including research on contamination and decontamination dynamics should be conducted. Endeavors should also be carried out to establish new methods of toxin levels estimation in affected marine species which should complement the currently-used technique of mouse bioassay [2,14,17].

### Problems and Issues of Marine Fisheries

A numerous of marine fisheries issues had been surfaced on Sabah with the output being published in term of research journal, statistical fisheries report, thesis dissertation and newspaper article. All form of output generally showed the condition of marine fisheries resources in Sabah which is declining day by day due to over-exploited of catch rate. Specifically, in Sabah, the influence of environmental factors, both natural (oceanographic, climate, primary production) and man-made (excluding fisheries and aquaculture), on the key biological parameters (e.g. recruitment, distribution, natural mortality) of aquatic resources should be studied [10,17]. Oceanographic research is important for proper exploitation and management of our fishery resources for fishery populations and their characteristics are closely related to the environmental conditions in which they are in [14]. Scientific information on marine environment in Sabah such as data and information on the physical oceanography (depth, air temperature, wind speed and direction, current, sea temperature, salinity and turbidity) chemical oceanography (dissolved oxygen, nutrients, and trace metals) biological oceanography (plankton) represent

an important foundation for fisheries resources management [16,18,20,21].

Several places in coastal area of Sabah had been selected in the study of fisheries resources. For instance, the catch rate of reef fisheries at Banggi Island were dropped three to four times for over last 20 years, with 2000 as the year when the catch rate were started to significantly declining [4]. Therefore, it is imperative to execute suitable preventive measures in order to control significance depletion of reef fish resources over there. The restriction of mesh size of the net will help to avoid the excess rate of catch of juvenile fish as reef areas around Banggi Island were known as main breeding site for various fish species [37].

Furthermore, Darvel Bay, Sabah, which is located in Sulu-Sulawesi Marine Ecology (SSME) region, is one of important bays in Sabah for the conservation of fish resources and habitats. However, a lot of illegal trawling activities by commercialized fishermen had been spotted over there as the enforcement is lack [13]. Commercialized fish species in Darvel Bay such as *Priacanthus tayenus* had showed significant declining in term of population of adult individual for the past few years [38]. Therefore, the limitation enforcement of trawling activities by the government authority will help the fisheries population in Darvel Bay to regain their optimum level [19].

As for management issues, there are conflicts and issues regarding management and conserving plan of coastline around Sabah, with each of their demand and desire are completely different towards each other [21]. The residents want consistent and stable growth of social and economy in their places without damaging the environment while the private sector have always desire maximum production of output by doing excessive and



uncontrolled development [2]. They also stated that several well-prepared plans had been started in resolving this type of problem by emphasizing quantitative and qualitative measurements such as making thorough checking of condition of coastline either by data collection of fish catch or photos of coastline [39].

The use of dangerous fishing methods and the practice of intensive fishing that can lead many fish species to the brink of extinction due to annihilation of their habitat and inability to spawn their progeny in sufficient time [40]. Some evidence or data (e.g. marine fish yield or total marine fish landed) had been showed in newspaper articles in order to send awareness sign for the government authority, the private sector and local community so that they can cooperate to each other and find suitable formula in solving the problems [41]. Instead of giving opinions and ways to prevent overfishing, newspaper articles also served as publicity or campaign platform for the government in showing to the public on what they had done in preserving the fisheries resources of Sabah [42].

On the other hand, the distribution, abundance and composition of most important commercial fish species in Sabah waters are still far from facing severe depletion [20]. This is because the abundance and availability of fish resources for most marine fishing areas in Sabah can be varied according to monsoon season as particular fish species require specific level of water quality to survive and inhabit those areas [43]. Therefore, the implementation of zones of fishing ground and marine district which are divided by the government authority, types of fishing gear and types of fisheries resources had proved to help Sabah in countering over-fishing problem [8].

## Conclusion

The marine fisheries sector in Sabah is nowadays facing with multiple challenges and problems that can lead to unsustainable status. Over-fishing, the destruction of fish habitat and weak law enforcement are some of the main reasons on why the situation happened for a long time ago. Therefore, the people of Sabah can still hope for fisheries in ensuring better development of their state as there are many advantages pertaining to this sector such as good government support, extensive yet untapped fish resources and technology improvement. Thus, the well-control exploitation of fish stocks in Sabah will be good procedures in distributing service and high quality products which will pioneer the development of state's marine resource. Moreover, numerous types of fisheries studies and researches in Sabah should be more frequently commenced as it can be excellent idea in promoting wise and precise fisheries management plan.

It is imperative for the government of Sabah to plan and execute ideal efforts in conserving the fisheries resources of the country from massive depletion that will bring extinction to some endangered aquatic species. The dynamics of fish stocks and fishing effort with its variables such as equilibrium catch, social profits, consumer surplus, social benefits, direct fisheries employment and income of individual crew are an important consideration in determining appropriate fishery management policy. In order to understand on how to implement excellence and precise fisheries management policies, the thorough

knowledge about the adjustment processes of fishing effort must be achieved first. Hence, the Fisheries Department of Sabah play pivotal role in preserving the fisheries resources of the country by enforcing strict fishery management policies and law to fisheries communities.

This paper had been carefully reviewed the present status of marine fisheries in Sabah by citing and using some information from past and present studies. Undoubtedly, the marine fisheries status in Sabah are shaped by 3 different types of dimension; biology, sociology and economy. Hence, data collection of fisheries statistic, publication of state's fisheries research and reports of state's fisheries status should be sufficient enough in determining the status level of marine fisheries in Sabah. Last but not least, it is hoped that any information extracted from this paper can be useful references to individuals, groups and parties who are involved direct or indirectly in fisheries management of Sabah.

## Acknowledgement

The author would like to thank Universiti Putra Malaysia (UPM) and Ministry of Science and Technology (MOSTI) for financial support under E-Science Fund Grant Scheme (Grant. No. 04-01-04-SF1207, Vot. No. 5450591).

## References

1. Abu T, Mohammad I, Mohamad SI, Sharum Y (2003) Status of demersal fishery resources of Malaysia. pp. 83-136.
2. Busing ER (2001) Assessment of Coastal Fisheries in the Malaysian-Sabah portion of the Sulu-Sulawesi Marine Ecoregion (SSME) WWF Malaysia. Buhavan Infotech, Sabah, Malaysia.
3. Galid RS (2001) Investment Prospects and Potential in the Fisheries Sector in Sabah. Department of Fisheries, Sabah.
4. Teh L, Cabanban AS, Sumaila UR (2005) The reef fisheries of Pulau Banggi, Sabah: A preliminary profile and assessment of ecological and socioeconomic sustainability. *Fisheries Research* 76(3): 359-367.
5. Vidthayanon C (1998) Species composition and Diversity of Fishes in the South China Sea, Area I: Gulf of Thailand and East Coast of Peninsular Malaysia. SEAFDEC.
6. Chia CB (1992) Ko-Nelayan's role and experience in increasing living standards. Workshop on Strategies to Reduce the Poverty Rate amongst Fishing Communities. Institute for Development Studies (IDS), Sabah, Malaysia.
7. Sabah Tourism (2002) Sabah Tourism Report 2000/2001. Sabah Tourism Promotion Corporation, Malaysia.
8. Ambak MA (2002) Sabah: The Fisheries Status. UPM Press Publication, Serdang, Malaysia.
9. Chin PK (1998) Marine food fishes and fisheries of Sabah. Natural History Publications, Kota Kinabalu, Malaysia.
10. Chua TE, Mathias JA (1978) Coastal resources of West Sabah. An investigation into the impact of oil spill. Penerbit Universiti Sains Malaysia, pp. 296.
11. Mohsin AKM, Ambak MA (1996) Marine fishes and fisheries of Malaysia and neighboring countries. Universiti Pertanian Malaysia Press, Serdang, Malaysia, pp. 743.

12. Department of Statistics (DOS) (2011) 2010 Population and Housing Census of Malaysia. Annual Bulletin of Statistics 2011. Department of Statistics, Sabah, Malaysia.
13. Integrated Coastal Zone Management Unit (ICZM) (1998) Sabah Coastal Zone Profile. Danish Cooperation for Environment and Development (DANCED). Town and Regional Planning Department, Kota Kinabalu, Sabah, Malaysia.
14. Busing ER (1995) Status of the coastal fisheries resources of Sabah. Paper presented at the Seminar on Sustainable Development of Fishery Resources, Kota Kinabalu, Malaysia.
15. Galid RS (1998) Prospects and Potential in the Fisheries Sector in Sabah. Paper presented at the Seminar Pembangunan Ekonomi Setempat Dalam Era Globalisasi. Institute Development Studies, Sabah.
16. Busing ER, Gambang AC, Jumin R, M Manjaji (1994) Demersal fisheries resources along the west coast of Sabah. Department of Fisheries, Sabah, Malaysia.
17. Busing ER, R Rumpet (1995) Results of demersal fishery resources survey along the Sarawak/Sabah waters during the 1996-1997 period. Draft technical report submitted to SEAFDEC.
18. Garces LR, Alias M, Abu Talib A, M Mohamad-Norizam M, GT Silvestre (2003) A trophic model of the coastal fisheries ecosystem off the West Coast of Sabah and Sarawak, Malaysia, pp. 333-352.
19. Awong H, Ibrahim S, Somo K, Ambak MA, (2011) Stock Assessment by Swept Area Method in the Darvel Bay, Sabah, Malaysia. World Journal of Fish and Marine Sciences 3(5): 361-365.
20. Rumpet R, Awang J, Musel E, Busing R (1998) Distribution, Abundance and Biological Studies of Economically Important Fishes in the South China Sea, Area II: Sarawak, Sabah and Brunei Darussalam Waters. Fisheries Research Center, Department of Fisheries, Sabah, Malaysia.
21. Jakobsen FN, Hartstein J, Frachisse T, Golingi (2007) Sabah shoreline management plan (Borneo, Malaysia): Ecosystems and pollution. Ocean & Coastal Management 50(1-2): 84-102.
22. Hilborn R, Walters CJ (1992) Quantitative Fisheries Stock Assessment. Choice, Dynamics and Uncertainty. Chapman and Hall, New York, USA, pp. 570.
23. Seijo JC, O Defeo, S Salas (1998) Fisheries bioeconomics: Theory, modeling and management. FAO Fisheries Technical Paper No. 368. FAO, Quebec City, Canada, pp. 108.
24. Walters CJ, Martell SJD (2004) Fisheries Ecology and Management. Princeton University Press, Princeton, USA, pp. 399.
25. Hoggarth DD, Abeyasekera S, Arthur RI, Beddington JR, Burn RW, et al. (2006) Stock assessment for fishery management – A framework guide to the stock assessment tools of the Fisheries Management Science Programme (FMSP). FAO Fisheries Technical Paper No. 487, FAO, Rome, Italy, pp. 261.
26. FAO (1997) Fisheries Management. FAO Technical Guidelines for Responsible Fisheries. No. 4. FAO, Rome, Italy, p. 68.
27. FAO (1999) Guidelines for the routine collection of capture fishery data. FAO Fisheries Technical Paper No. 382. FAO, Rome, pp. 113.
28. Pauly DG, Gaschutz (1979) Simple method for fitting oscillating length growth data with a program for pocket calculator. ICES, Denmark, p. 26.
29. Pauly DN, David (1981) ELEFAN I, a basic program for the objective extraction of growth parameters from length-frequency data. Meeresforsch 28(4): 205-211.
30. Pauly D (1984) Fish population dynamics in tropical waters. A manual for use with programmable calculators. ICLARM Contribution No. 143, Manila, Philippines.
31. Polovina JJ (1984) Model of a coral reef system I: the ECOPATH model and its application to French Frigate Shoals. Coral Reefs 3: 1-11.
32. Polacheck TR, Hilborn AE, Punt (1993) Fitting surplus production models: comparing methods and measuring uncertainty. Canadian Journal of Fisheries and Aquatic Sciences 50(12): 2597-2607.
33. Maunder MN, Punt AE (2004) Standardizing catch and effort data: a review of recent approaches. Fish Res 70: 141-159.
34. Department of Fisheries (DOF) (2013) Marine Fisheries Statistics – State of Sabah. Department of Fisheries, Sabah, Malaysia.
35. FAO (1995) Fisheries Management. FAO Technical Guidelines for Responsible Fisheries. No. 4. FAO, Rome, Italy, p. 68.
36. FAO (1996) Guidelines for the routine collection of capture fishery data. FAO Fisheries Technical Paper No. 382. FAO, Rome, Italy, pp. 113.
37. Teh L SL, Zeller D, Cabanban S U, Rashid (2007) Seasonality and historic trends in the reef fisheries of Pulau Banggi, Sabah, Malaysia. Coral Reefs 26: 251-263.
38. Awong HS, Ibrahim K, Somo MA, Ambak, (2011) Observation on Weight Length Relationship of *Priacanthus tayenus* (Richardson, 1846) Species in Darvel Bay, Sabah, Malaysia. World Journal of Fish and Marine Sciences 3(3): 239-242.
39. Rayner SG (2001) Investment Prospects and Potential in the Fisheries Sector in Sabah Fisheries Department of Sabah, Malaysia.
40. Anonymus (2012) Two more projects to release aquatic life into rivers. Borneo Post, p. A2.
41. Morpi M (2012) Shrinking marine resources threaten fishery, tourism. Borneo Post, p. 4.
42. Mu P (2012) Overfishing contributes to diminishing fishery resources. Borneo Post, p. 12.
43. Toha T (2008) The Influence of Seasonal Changes on Physico-Chemical Characteristics of Seawater in Sepangar and Gaya Bays, Sabah. Master Thesis, Borneo Marine Research Institute, Universiti Malaysia Sabah.