

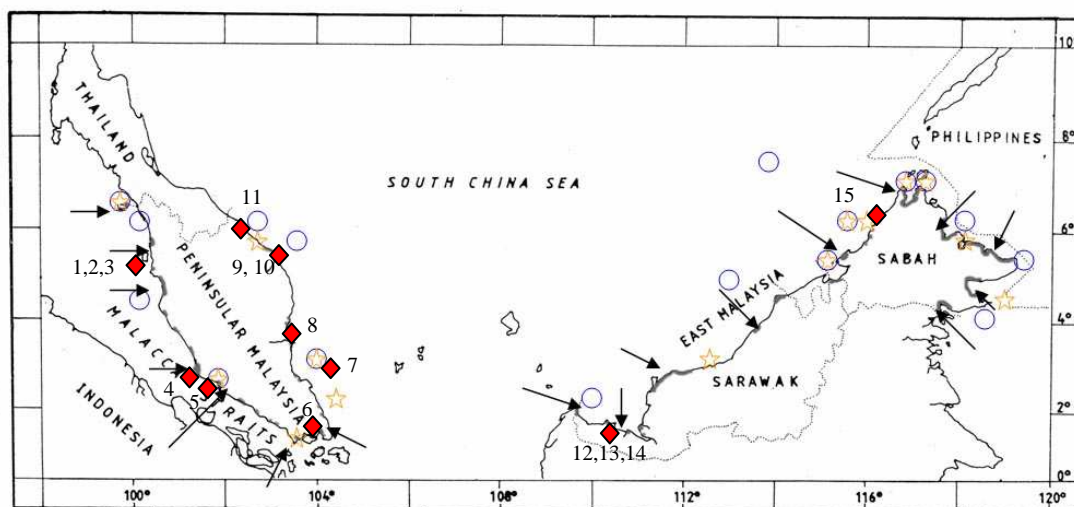
# Marine Biodiversity and Conservation in the South China Sea, with Emphasis on Ichthyofauna (Malaysia)

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## EXTENDED ABSTRACT

Malaysia comprises two land masses separated by the South China Sea (SCS). With a total landmass of 330,000 km<sup>2</sup>, territorial waters of 546,500 km<sup>2</sup> and a coastline of 4,675 km, the maritime nation boasts of three of the world's most productive habitats: mangroves, coral reefs and seagrass meadows (Fig. 1). Coastal mangroves cover 5,669 km<sup>2</sup> while coral reefs occupy an estimated area of 4,006 km<sup>2</sup>. Indeed the SCS and adjoining waters are home to a third (previously half) of the world's mangroves and a third of the world's coral reefs. Seagrass meadows here are considered the most diverse in the world. Thus, the large expanse of ocean space and varied marine habitats provide good opportunities for colonization by a diversity of fish and other marine fauna.



**Figure 1.** Major coastal habitats and marine research institutes/ stations in Malaysia.

Mangrove forests (green, arrowed), coral reefs (blue circles), seagrass meadows (orange star). Marine research institutes, centres and stations indicated by red diamonds: 1,2, 3) Fisheries Research Institute, World Fish Centre, Centre for Marine & Coastal Studies, University Science Malaysia; 4) Mangrove Research Centre (University of Malaya-Sime Darby); 5) Putra University Malaysia (UPM); 6) University of Technology Malaysia (UTM); 7) Pulau Tioman Research Station (Marine Parks Malaysia); 8) Institute of Oceanography & Maritime Studies (International Islamic University of Malaysia); 9, 10) SEAFDEC, Institute of Oceanography (University Malaysia Terengganu- UMT); 11) Institute of Ocean & Earth Sciences or IOES (University of Malaya); 12, 13, 14) University Malaysia Sarawak (UNIMAS), Fisheries Research Institute Sarawak Branch; Sarawak Museum; 15) Borneo Marine Research Institute or BMRI (University Sabah Malaysia).

A recent review of Malaysia's ichthyofauna estimates a total of 1951 species (including 470 species of freshwater species) with 296, 925 and 182 species from mangrove, coral reef and seagrass, respectively (Table 1). Interestingly, 178 fish species had been recorded from mixed mangrove and seagrass habitats, while 110 species were from mixed mangrove and coral habitats, indicating the possibility of usage of multiple biotopes by marine fish species to complete their life history. Unfortunately, habitat connectivity studies are nil or very few in the SCS, so are ecological studies identifying temporal patterns or exploring fish-habitat interactions. The problem lies in the general lack of interest attributable to the limiting meteorological and ocean conditions, inadequate infrastructural, logistical and technological support (see Figure 1), lack of scientific man-power capacity and insufficient research funding.

**Table 1.** Fish richness of Malaysian marine and freshwater habitats

Type of fish	Habitat type	No. of species
Freshwater (470 spp.)	Streams	314
	Rivers	291
	Lakes and ponds	70
	Peat swamps	92
	Other freshwater swamps	78
	Paddy fields	9
Brackishwater (81 spp.)	Estuary	326
	Mangroves	296
	Seagrass meadows	182
	Mixed mangrove & seagrass	178
Marine (1400 spp.)	Coral reefs	925
	Mixed mangrove & coral	110
	Coastal waters	539
	Offshore waters	100
<b>Total no. of species</b>		<b>1951</b>

Source: Chong et al. (2010). J Fish Biol. (doi:10.1111/j.1095-8649.2010.02685.x)

Although the Department of Fisheries had begun extensive fish resource surveys as early as 1970, albeit irregularly, such surveys including trawling and the use of acoustics serve mainly the purpose of stock assessment. Other studies result from the requirement of environmental impact assessments made mandatory for large scale developmental projects such as constructions of coastal resorts and jetties, dredging, sand mining, and offshore oil extraction. Recent more concerted research stems from realization of the importance of the SCS as part of the region/global ocean-atmospheric regime and its huge contribution to the socio-economy of the country via its rich biodiversity and ecosystem services. For instance, present fisheries catches (2006) from the SCS amount to an annual total of 740,000 metric tons of mainly pelagic fishes and squids with an economic value of USD842 million (RM2694 million). The SCS fisheries in Malaysia sustain 66 coastal fishing communities (districts) with an estimated 60,500 fishermen directly dependent on fishing for their livelihood.

Resource use impacts however have caused the fall in demersal and pelagic shrimp landings (due to mangrove area reduction) and the decline of the coral reef fishery (due to poor reef health). A recent review identifies the leading causes of threat to Malaysian fishes as habitat degradation, over-harvesting and by-catch. Fifteen marine fishes are considered highly threatened, while another 123 species are moderately threatened.

Coral reef research is perhaps the most prominent in the SCS compared to that of other coastal habitats. Coral species and reef-associated species of seaweeds, invertebrates and vertebrates are relatively well studied, although largely pertaining to checklists and distribution. At the centre of much controversy and concern are the Humphead Wrasse and several coral reef groupers relentlessly hunted for the live reef fish trade. The demand for seahorses and pipefishes from China and Taiwan for traditional Chinese medicine has

similarly endangered local populations. Extreme fishing methods have caused massive destruction of marine habitats including exacerbating the problem of by-catch and discards. Sharks and rays, slaughtered for their fins and discarded at sea, had been the subject of study by SEAFDEC, with the discovery of some rare/new species of sharks, sawfish and stingrays. The Tropical Shad is rarely reported in the Straits of Malacca where a substantial fishery existed in the 70s. Substantial populations are perhaps only confined to the Batang Lupar estuary and coastal waters of the state of Sarawak (SCS). Because of its unique biology, highly-priced roe and depleted population, the fish's ecology had been intensely studied by the state with the assistance of CSIRO experts to conserve the species. By-catch and fishing of sea turtles, including egg hunts, have been a contentious issue, particularly, since it involves indigenous hunting rights and illegal poaching. Sea turtle populations in SCS are considered critically endangered, and for many years, SEATRU (UMT) and the Sarawak Museum have been conducting research on their population dynamics, migratory behavior, reproductive ecology and habitat requirements. The elusive dugong, with a distribution that highly correlates to large seagrass meadows, is being studied by the IOES and BMRI to understand their low population numbers and to assess the threats to their survival. Similarly, there are many other cases of marine biodiversity impacted by anthropogenic causes. Global climate change including elevated sea temperature, sea level rise and ocean acidification are emerging issues. Their effects superimposed on those of habitat degradation, overexploitation and pollution are estimated to have far reaching effects on coastal habitats, marine species and human communities of the SCS. The past studies have shown that the current problems and issues of marine biodiversity and management (in the present scenario of global climate change), as similarly experienced by nations of the SCS, are best addressed through regional collaborative research with expertise from outside the region.

## 南海的海洋生物多樣性與保育—以魚類區系（馬來西亞）為重點

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### 摘要

馬來西亞是由兩塊被南海分隔的陸地所組成。陸地面積為三十三萬平方公里，領海面積為五十四萬六千五百平方公里，海岸線總長四千六百七十五公里，涵蓋了全球三個物種：紅樹林、珊瑚礁，與海草床最多的海洋國家(圖 1)。沿岸紅樹林覆蓋伍仟六百六十九平方公里的地區，而珊瑚礁約佔四千零六平方公里的面積。事實上，全世界三分之一的紅樹林(以前是一半)以及三分之一的珊瑚礁都生長在南海與其鄰近海域。這地區的海草床是全世界最具多樣性的。因此，遼闊的海洋空間與多樣的海洋棲地，透過魚類與其它海洋生物的多樣性提供了群殖的絕佳生機。

一項最近針對馬來西亞魚類區系所作的普查，估計有二百九十六種紅樹林、九百二十五種珊瑚礁，與一百八十二種海草，總共有一千九百五十一種(包括四百七十個淡水種)(表 1)。值得注意的是，在紅樹林與海草混生的地區曾發現一百七十八種魚類的記錄，而在紅樹林與珊瑚的混生棲地則有一百一十種，這顯示出海洋魚類能利用多重群聚棲地來完成其生活史的可能性。可惜的是，對於南海海域缺乏關於棲息地連接性的研究，即使有也相當有限，另外在關於確認時態模式或探討魚類與棲地互動關係方面的生態研究也有同樣的情形。問題在於有限的氣象學與海洋相關條件、不充足的基礎結構、後勤與技術支援而對忽略了這個區域(參閱圖 1)，另外也是因為缺少科學方面的人力資源與足夠的研究經費。

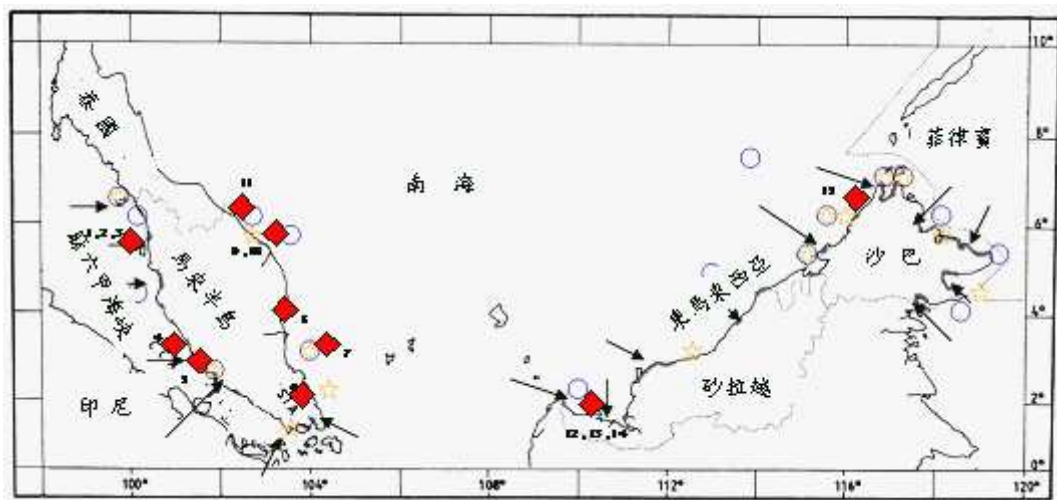


圖 1. 馬來西亞的主要沿海棲地與海洋研究機構/觀測站

紅樹林(綠色箭頭所指處)、珊瑚礁(藍色圈起處)、海草床(橙色星號處)，海洋研究機構、中心，與觀測站以紅色菱形標示：1、2、3)漁業研究所、全球魚類研究中心、馬來西亞理科學大學海洋與沿海研究中心；4)紅樹林研究中心(馬來亞-森那美大學)；5)馬來西亞博特拉大學；6)馬來西亞理工大學；7)刁曼島研究站(馬來西亞海洋公園)；8)海洋學與海洋研究所(馬來西亞國際伊斯蘭大學)；9、10)東南亞漁業發展中心、海洋學研究所(馬來西亞登嘉樓大學)；11)海洋與地球科學研究所(馬來亞大學)；12、13、14)馬來西亞砂拉越大學、漁業研究所砂拉越分所、砂拉越博物館；15)婆羅洲海洋研究所(馬來西亞沙巴大學)

**表 1.** 馬來西亞海洋與淡水棲地的魚類豐度

魚種類型	棲地類型	種 數
淡水 (470 種)	溪流	314
	河川	291
	湖泊與池塘	70
	沼澤	92
	其它淡水沼澤	78
	水田	9
半鹹水 (81 種)	河口	326
	紅樹林	296
	海草床	182
	紅樹林與海草混生	178
海水 (1,400 種)	珊瑚礁	925
	紅樹林與珊瑚礁混生	110
	沿海海域	539
	近海海域	100
總 數		<b>1,951</b>

資料來源: Chong et al. (2010). J Fish Biol. (doi:10.1111/j.1095-8649.2010.02685.x)

雖然漁業局早在 1970 年就開始普遍進行漁業資源的調查，儘管是不定期性質，但是這些調查都包括了拖網與聲探流速儀的使用，主要是用來進行現存漁量的推估。另外，還有針對例如建造沿海度假村與防波堤、挖泥、採沙、以及近海鑽油等大型開發專案，依規定必須強制進行的環境影響評估的一些其它研究結果。還有，最近更具協調性質的研究，也是因為體認到南海是區域/全球海洋大氣環境的一部份，以及其豐富的生物多樣性與生態系服務對於國家社經重大貢獻的重要性。例如，目前產自南海主要是遠洋魚類與魷魚的每年漁獲總量(2006)達到七十四萬公噸，而經濟產值也達八億四千二百萬美元(馬幣二十六億九千四百萬)。馬來西亞的南海漁業維繫了六十六個沿海漁業群聚(地區)中約六萬伍佰名直接依賴漁業為生的漁民。

然而，濫用資源的衝擊已經導致深海與遠洋蝦類捕獲量降低(因為紅樹林面積減少)，以及珊瑚礁漁業的衰落(因為健康惡化的礁脈)。有一項最近的調查指出，威脅馬來西亞魚類的最主要因素是棲地劣化、過度捕獵與混獲。有十五種海水魚被認為受到嚴重威脅，而另外有一百二十三種則受到中度威脅。

與其它沿海棲地的研究相較之下，南海的珊瑚礁研究可以說是最重要的了。雖然必須配合相關的大量直接計數法與分佈推估，但是對於珊瑚與礁體棲性的海草類、無脊椎動物、脊椎動物等物種都普遍作了相當仔細的研究。許多爭議與關注的焦點是，波紋唇魚與多種珊瑚石斑魚都因為活礁石魚貿易而被無情的獵捕。中國與台灣因為傳統中藥對於海馬與海龍魚的需求，也同樣危及當地群體數量。偏激的捕魚方式已經造成海洋棲地的破壞，這包括讓問題更加惡化的混獲捕獵與丟棄漁獲。鯊魚與魷魚因為要取鰭而被屠殺並棄置海邊，這一直是東南亞漁業發展中心的研究課題，同時也發現了一些稀有/新種的鯊魚、鋸鯊與刺魷。熱帶鯆在麻六甲海峽已很罕見，而當地在 70 年代的漁獲量極大。大量魚群也僅限於魯巴河河口與砂拉越沿海水域(南海)。因為其特殊的生物學特性、高價格的魚子，以及遺存的群體數量，使得該魚種的生態在政府當局與澳洲聯邦科學與工業研究組織專家的協助下，進行仔細研究並得以保育其物種。混獲與捕獵海龜，包括獵蛋，一直都是爭議的焦點，尤其這也牽涉到原住民的捕獵權和非法盜獵的問題。南海的海龜數量嚴重的瀕臨絕滅，許多年來，馬來西亞登嘉樓大學的海

龜研究小組與砂勞越博物館就一直在研究其族群動態、洄游行為、繁殖生態學與棲地環境的需求。高度依存廣闊海草床的儒艮，也由海洋與地球科學研究所與婆羅洲海洋研究所進行研究，來了解其低群體數量，並判別危害其生存的各種威脅。同樣，還有許多海洋生物多樣性的其它案例，也都是受到人為因素的影響所造成的。全球氣候變遷包括海水溫度上升、海平面升高，與海洋酸化等，都是新出現的問題。這些效應突顯了棲地劣化、過度開發，與汙染問題，預期更將會影響到南海的沿海棲地、海洋物種，以及人類社群。以往的研究已經顯示，目前黃海週邊國家所共同面臨的海洋生物多樣性與處理(在目前的全球氣候變遷情況下)方面的問題與議題，最好是透過由區域以外專家所協助的區域性合作研究來處理。