

THE MARINE FLORA AND FAUNA OF HONG KONG AND SOUTHERN CHINA V

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COASTAL ZONE MANAGEMENT FOR MARINE CONSERVATION IN HONG KONG: THE NEED FOR REGIONAL CO-OPERATION IN SOUTHERN CHINA

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ABSTRACT

The Marine Parks Ordinance Chapter 37, 1995 came into effect on 1 June 1995 allowing and providing the framework for designation in 1996 of Hong Kong's first marine parks and reserves.

Two parks and one marine reserve received designation on 5 July 1996. The parks are Yan Chau Tong/Li Chi Wo in northeastern waters to protect a rich marine diversity including the single remaining grove of the mangrove *Heritiera littoralis* and the most important bed of the seagrass *Zostera nana* (= *Z. japonica*), and Hoi Ha Wan, also in the northeast, for its corals, dynamic sand beach, lagoon and mangrove stand. The marine reserve is at Cape d'Aguilar on the southeastern tip of Hong Kong Island to protect a wide diversity of marine intertidal and subtidal habitats in a small, 18 hectare, area of sea. The islands of Lung Kwu Chau and Sha Chau, plus One Tree Island and 1,200 hectares of surrounding water in the northwest, were designated on 22 November 1996 as a marine park for the protection of a small population (~ 110 individuals) of the Indo-Pacific Hump-backed (or Chinese White) dolphin, *Sousa chinensis*. On 30 July 1999, the only beach where the Green turtle, *Chelone mydas*, is known to nest, at Sham Wan on Lamma Island, was declared a Restricted Area during the breeding season (June to October). There are also plans to designate the island of Ping Chau, in Hong Kong's northeastern waters, as a marine park. This was endorsed by the Executive Council of the Hong Kong Government on 5 May 2000.

The Mai Po Marshes Nature Reserve (actually a restricted area not a statutory reserve) in the northwestern waters of Hong Kong was designated a RAMSAR site on 4 September 1995 and is justly famous as a stop-over place for migrating waterbirds and a habitat of mangroves, *Phragmites* reeds, fish ponds, prawn ponds (*gei wai*) and other wetlands. There are also 27 marine Sites of Special Scientific Interest (SSSI) in Hong Kong, including Sham Wan and Ping Chau.

The integrity of all these parks, reserves and areas is, however, still threatened and, when examined, seen to be located and surviving at the periphery of Hong Kong's

Special Administrative Region's marine territorial boundary. Survival is at the edge. Within China, to the north of Mai Po is the Futien National Nature Reserve; to the east is the Gankou National Nature Reserve and the only location on the mainland coast (except Sham Wan, on Lamma Island) where the Green turtle, *Chelone mydas*, still comes ashore to nest in significant numbers (~ 100 per season).

Southern China is undergoing rapid development so that the pollution threats to Hong Kong's marine parks and reserves are, now, both internal and external. This paper describes briefly Hong Kong's marine parks and reserves and those adjacent, within the broader context of Southern China, and identifies the threats they all face. The marine conservation laws, especially the accessory regulations, of the Hong Kong Special Administrative Region and China, it is argued, have to be integrated if local parks and reserves are to survive. This will necessitate much closer cross-border consultation if coastal zone management for conservation is to succeed.

INTRODUCTION

The territorial waters of Hong Kong's Special Administrative Region comprise 1827 km² or, approximately, 1.5 times that of the land area of 1054 km². Western waters, under the influence of the Pearl River, are estuarine. Conversely, eastern shores are washed by oceanic waters and, as yet largely undeveloped, are considered to be Hong Kong's cleanest. Some 50 (actually 52) species of reef-building corals have been recorded from these waters (Scott 1984). Between low-lying, estuarine west and precipitous, oceanic east is a central transition zone of intermediate hydrography which accommodates the largest urban centres of Victoria, on Hong Kong Island, and Kowloon on the mainland peninsula separated by polluted Victoria Harbour (Connell *et al.* 1998). Also in this zone, in the New Territories, are the still growing cities of Shatin, Tai Po and Ma On Shan, around similarly polluted Tolo Harbour.

For such a small area, the deeply-incised coastline of Hong Kong is long, amounting to approximately 800 km. There is (was) great marine habitat diversity (Morton and Morton 1983). Sheltered bays accommodate beaches of mud and sand with mangroves, salt meadows and seagrasses. Rocky headlands encompass a wide array of communities resulting from varying degrees of exposure to wave action. Located at 22°N and 114°E, Hong Kong lies within the tropics on the northern coastline of the South China Sea and the seasonal interplay of the northeast and southeast monsoons creates a climate of cold, dry winters and hot, wet summers. Summer rains cause the Pearl River, to the west, to flood, increasing its influence at this time. The monsoonal climate brings cold North China Coast Water (the Taiwan Current) to Hong Kong in winter and warm South China Sea Water (the Hainan Current) in summer. A finger of the Kuroshio also enters the South China Sea in winter, *via* the Luzon Straits, adjacent to Hong Kong, keeping sea temperatures warm enough (15°C) to sustain coral communities over the brief cold period. Coastal communities are, therefore, spatially and temporally diverse with a prevailing tropical influence, there being, or were, for example, extensive areas of mangrove and a hermatypic coral reef community. Conversely, the dominant urchin on Hong Kong's rocky beaches is the black *Anthocidaris crassispina*, here at the southern edge of its temperate range. Temporal changes are also best seen on rocky shores where temperate algae (notably *Sargassum*) grow only in winter (Morton and Morton 1983).

and summer is characterized by soaring rock temperatures (50°C), microalgal bleaching and macroalgal die-back and 'kills' of some components of the intertidal fauna, e.g., barnacles and limpets (Liu and Morton 1994). The biogeographic location of Hong Kong, the climate, a complex geology, the varied influence of sea currents, proximately to the Pearl River, the long drowned coastline, numerous islands, wide variations in the degree of exposure to wave action and a broad, shallow, continental shelf have all melded to create the potential for a wide diversity of marine habitats (Morton *et al.* 1996). As a consequence, there is a highly diverse marine life, many of the intertidal components of which have been described by Morton and Morton (1983).

Because of the early absence of comprehensive planning, virtually all of Hong Kong's urban sewage and industrial effluents enter the waters of the central hydrographic transition zone, encompassing Victoria Harbour and Tolo Harbour, largely untreated, making it highly polluted and ecologically degraded. The development of Hong Kong is still proceeding, however, and most of it is coastal so that, today, the management of intertidal and inshore resources is of increasing importance locally (Morton 1995). It is now estimated that 20% of Hong Kong's coastline is reclaimed. This is especially moment from an ecological point of view because coastal reclamation for development, dredging for marine fill, marine dumping, intensive and highly destructive fishing practices and pollution have combined in near-total destruction of what was once a marvel of marine biodiversity (Morton 1996a). Hong Kong's marine environmental problems are many-fold and the demands upon inshore waters are growing for every use and this has created an awareness that there is now the need for coastal zone planning and management. An important component of such planning is the Marine Parks Bill, passed into law by Hong Kong's Legislative Council on 31 May 1995, coming into effect as an Ordinance on 1 June 1995, and which allowed for the designation of marine protected areas locally (Wong 1998).

Coastal zone planning and management need to be among the Hong Kong Government's highest priorities because there are indications that the marine parks and reserves will not be successful (Morton 1996a). The threats to them are too great. Conservation legislation and coastal planning exercises should also be integrated with those of China beyond the boundaries of the Special Administrative Region as soon as possible, especially for areas of coastline surrounding Hong Kong. This is because development within surrounding southern China is proceeding at such a pace that Hong Kong's marine protected areas are now being threatened, as this paper will attempt to demonstrate, by external factors as well as internal ones. Cross border co-ordination and integration with regard to common pollution problems was advocated by Liu *et al.* (1998) and, as will be seen, the Hong Kong Guangdong Environmental Protection Liaison Group is attempting to achieve progress in this respect. Pollution and development, however, are acting most rapidly at the most sensitive species, habitats and ecosystems and, as will be argued, their local protection should have the highest priority within the broader picture of marine conservation in China.

MARINE CONSERVATION IN HONG KONG

The responsibility for Hong Kong's environment, at the policy level was, until 1999, with the Secretary for Planning, Environment and Lands. Administrative departments

included those of Planning, Lands, Environmental Protection (EPD) and Agriculture and Fisheries (AFD). This changed in 2000 with the environment coming under the purview of a new Secretary for the Environment and Food and with the establishment of a new department of Food and Environmental Hygiene, and the transfer to it of the Environmental Protection Department and the (renamed) Agriculture, Fisheries and Conservation Department (AFCD) (Morton 1999a). Since 1972, a wide body of legislation that allows for the control of an array of activities related to the environment, including the sea, has been enacted. For the purposes of this study, however, the most important legislation is the Marine Parks Ordinance (1995) and its Regulations, which came into effect from 15 July 1996 and allows for the establishment of marine parks, reserves and areas and their management. Initial sites have been designated (Fig. 1) and will be described briefly.

The need to protect Hong Kong's marine environment by the establishment of marine parks and reserves has been recognized since the mid 1970s (Morton 1976, 1979). Hong Kong's first coastal Sites of Special Scientific Interest (SSSI), that is, Tai Tam Bay and Cape d'Aguilar on Hong Kong Island, for example, were not gazetted until 24

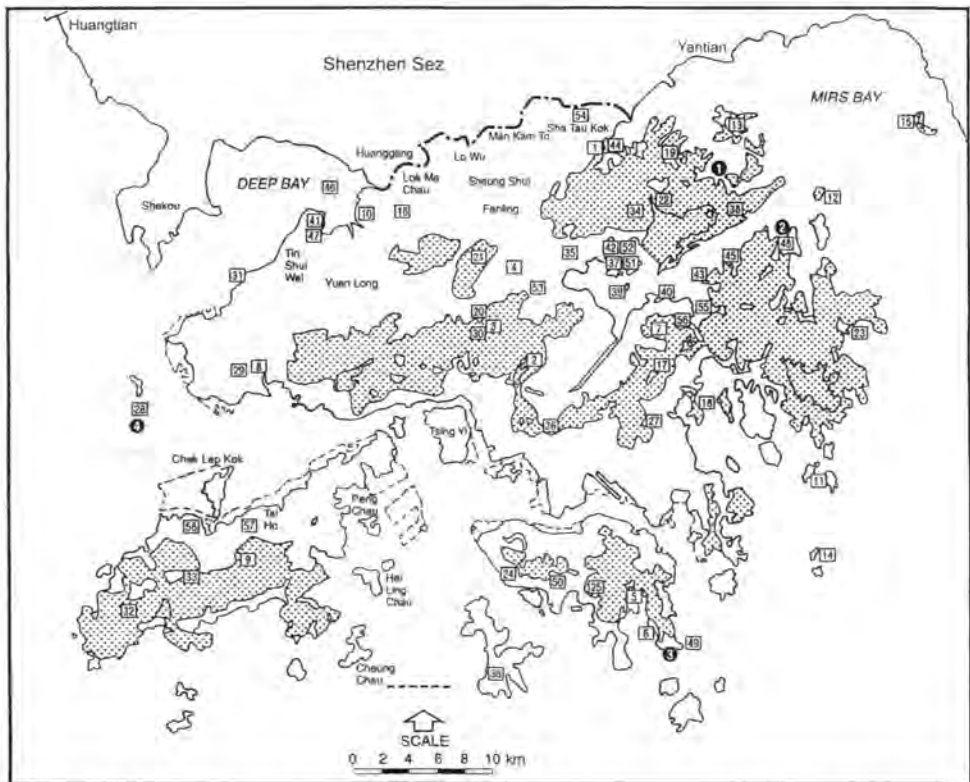


Fig. 1. A map of Hong Kong and its inshore waters showing the locations of country parks and special areas (stipped areas), Sites of Special Scientific Interest (numbers, 1–58, in squares) and marine parks and reserves (numbers, 1–4, in black circles).

October 1975. Since then, 27 coastal SSSI's have been identified (Morton 1998) (Fig. 1) although their designation is of little practical importance: only cognisance of their significance being required when developments are considered. This is because such sites are proposed by the Agriculture, Fisheries and Conservation Department, along with Conservation Areas and Green Belts, Under the Town Planning Ordinance but are, thereafter, the responsibility of the Planning Department.

A Marine Parks and Reserves Working Group, comprising marine ecologists, government officials and fishermen's representatives, was established in 1989, with a brief to investigate the feasibility of establishing marine protected areas in Hong Kong. The working group completed its report in December 1990 and the public, fishermen's organizations, rural communities and conservation groups were consulted with regard to its proposals in 1992. This was followed by the drafting of the Marine Parks Bill. The resulting Marine Parks Ordinance (1995) provides the framework for the designation, development and management of marine parks, reserves and special areas in Hong Kong. On 10 August 1995, the Country Parks Board was renamed the Country and Marine Parks Board and the Marine Parks and Reserves Working Group became the Marine Parks and Reserves Committee with a responsibility to make recommendations to its parent board with regard to the designation and management of Hong Kong's marine parks and reserves.

Hong Kong's marine parks and reserves

The Mai Po Marshes Nature Reserve

The Mai Po Marshes Nature Reserve is the most significant local wetland and covers an area of some 380 hectares of reclaimed land on the northwestern shoreline of Hong Kong, fringing the southeastern edge of Deep Bay (Fig. 2). It comprises 209 hectares of fish ponds and tidally flushed prawn ponds (*gei wai*) and a 172 hectare coastal strip of mangroves (Irving and Morton 1988). Some of the ponds have been converted into other wetland habitats, thereby increasing the habitat diversity of the reserve. Lee (1993) inventories 81 species of invertebrates from Mai Po, of which 13 (16%) are undescribed. The Mai Po mudflats are the only location in Hong Kong where the fiddler crab *Uca paradussumieri* has been recorded (Jones and Morton 1994).

Recognized internationally as of vital importance for resident and migratory birds, Mai Po is managed by the World Wide Fund for Nature Hong Kong for conservation and nature education purposes. There is a field studies centre within the reserve and about 40,000 people, mostly schoolchildren on organized visits, experience this unique wetland at first hand. WWFHK also organizes local and regional training courses for teachers and wetland managers. The 'reserve' is not actually a designated reserve, only a component of the Deep Bay Site of Special Scientific Interest (SSSI), a Restricted Area under the Wild Animals Protection Ordinance and a declared Nature Conservation Area (June 1975) under the Town Planning Ordinance. The justification for a local SSSI being afforded reserve status was, however, substantiated on 4 September 1995, when the inner Deep Bay area comprising 1500 hectares of wetland including the Mai Po Marshes Nature Reserve was designated a RAMSAR site by the Hong Kong Government. Some 270 species of birds have been recorded from Mai Po. Of these, almost 80 are resident, but the others are visitors and passage migrants. In winter, for

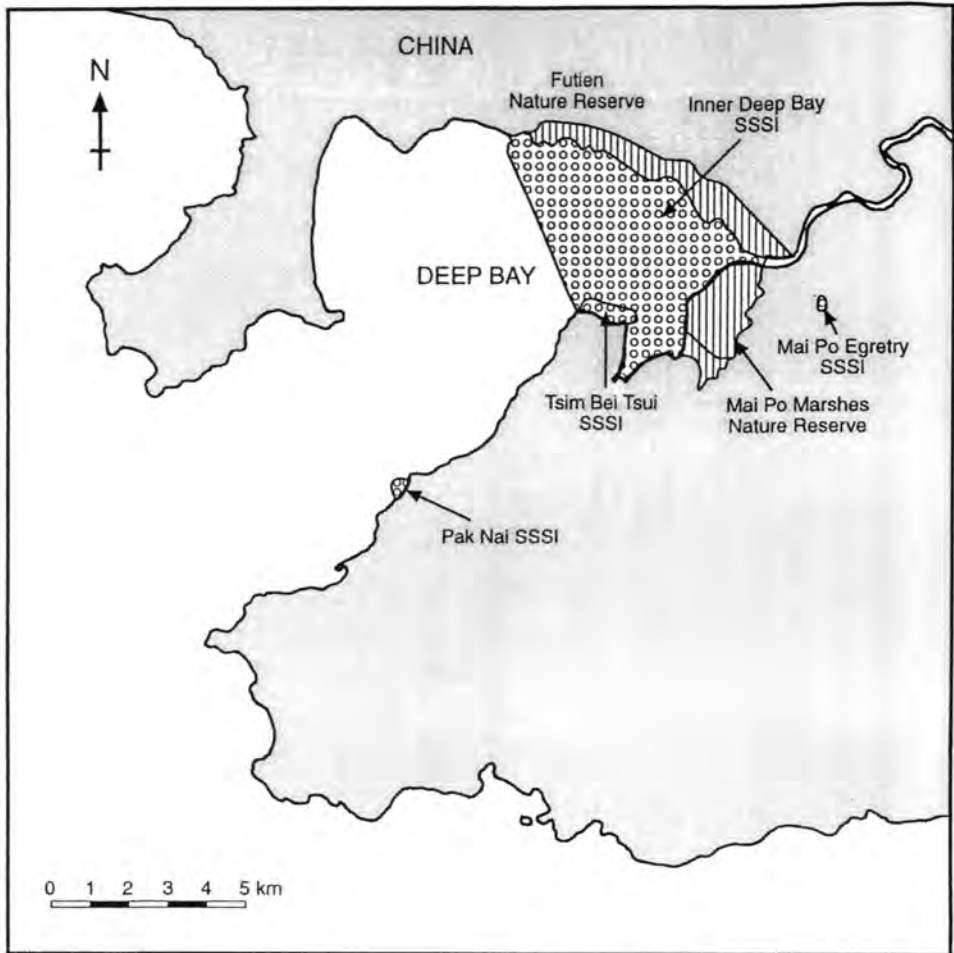


Fig. 2. The Mai Po Marshes Nature Reserve, the Futien Nature Reserve and the Deep Bay and Pak Nai Sites of Special Scientific Interest (SSSI) in the northwestern waters of Hong Kong (After Young and Melville 1993).

example, some 65,000 waterbirds may visit the reserve and although in early summer there are fewer (20,000–30,000), on any one day there may be 10,000 present (Young and Melville 1993). Mai Po is clearly a very important stopover place for birds migrating into and out of China and where, it is believed, similar habitats are declining steadily. In 1999, the Planning Department of the Hong Kong Government created a Wetland Conservation Area under the Town Planning Ordinance along the shores of Deep Bay, and including Mai Po, surrounded by a Wetland Buffer Area.

Hoi Ha Wan Marine Park

The marine park at Hoi Ha Wan is a sheltered bay situated in the northeastern quadrant of Hong Kong. It has a sea surface area of about 260 hectares (Figs. 1 and 3) and is

confluent with the Sai Kung Country Park. The bay has a rich coral community on its flanks (Cope and Morton 1988; Zou *et al.* 1992; Collinson 1997) and at its head there is a dynamic sandy beach behind which is a lagoon, locked in place by complex sand spits, with a small mangrove community (Morton and Ong Che 1992). The bay and its ecological significance are described by Morton and Ruxton (1992) and further details are available in a series of papers contained in Morton (1992a). The World Wide Fund for Nature Hong Kong (WWFHK) has plans currently in hand to build a Marine Life Centre at Hoi Ha, with funds donated by the Hong Kong Jockey Club.

Yan Chau Tong /Lai Chi Wo Marine Park

The marine park of Yan Chau Tong/Lai Chi Wo is also in the northeastern New Territories of Hong Kong and comprises the highly indented bay of Yan Chau Tong and a smaller area east of the village of Lai Chi Wo: it has a total sea area of about 680 hectares (Figs. 1 and 3). Little is known of this area, but Lai Chi Wo is the only site in Hong Kong where the mangrove *Heritiera littoralis* forms a distinct grove (Morton and Morton 1983) and the only situation where there are thriving seagrass (*Zostera nana* (= *Z. japonica*) and *Halophila ovata*) beds (Fong, 1999). The remoteness of the site, confluent with the Plover Cove Country Park and the lack of any developments, its highly indented coastline, variety of intertidal habitats and subtidal corals, make it a valuable, relatively large conservation area.

Lung Kwu Chau and Sha Chau Marine Park

The northwestern waters of Hong Kong, in particular the area around the islands of Lung Kwu Chau, Sha Chau and One Tree Island are important feeding, breeding and nursery grounds for a small population (~ 110 individuals) of the Indo-Pacific Hump-backed, or Chinese White, dolphin (*Sousa chinensis*) (Figs. 1 and 4). Local survival of the species is being affected by the cumulative effects of pollution, habitat loss, reduction in food availability and stress caused by development projects in surrounding waters (Porter *et al.* 1997). This area is undergoing major development in the form of the new international airport at Chek Lap Kok with major infrastructural coastal road and rail links to the rest of Hong Kong. This area is also a major focus of Hong Kong's road, rail, air and maritime trade links with the rest of southern China (Morton 1996a). Such northwestern waters, congruent with the Pearl River, the Special Economic Zone of Shenzhen, the Macao Special Administration Region (since 1999) and the Province of Guangdong in China, are a natural waterway facilitating trade between Hong Kong and southern China.

Recognising the potential for impacts upon the dolphin population by the building of an Aviation Fuel Receiving and Related Facility (AFRF) on Sha Chau for the new airport, a consultant was paid to identify practical mitigation measures (Würsig 1995). The study, surprisingly suggested that the AFRF was unlikely to have any significant negative effects on the dolphins as a population but that consideration must be given to the potential harm from the cumulative effects of this and other developments. Recommended also was the creation of 1200 hectare marine park which would serve as a dolphin sanctuary in the waters around Sha Chau and Lung Kwu Chau (Würsig 1995). This was designated on 22 November 1996 (Fig. 4).

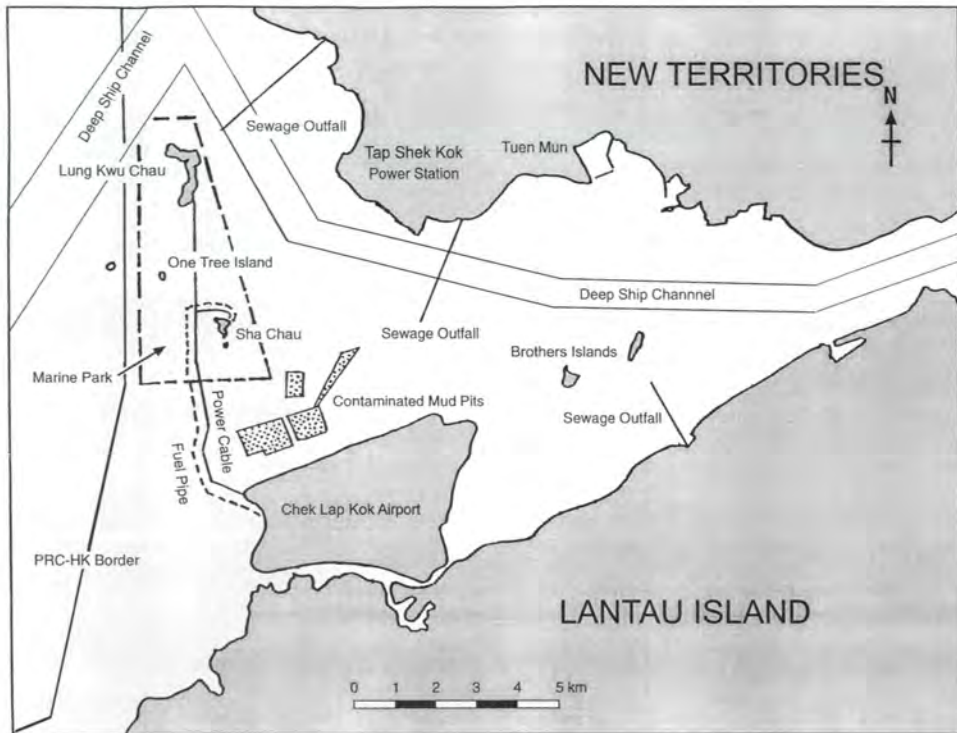


Fig. 4. The marine park at Lung Kwu Chau, Sha Chau and One Tree Island in the northwestern waters of Hong Kong for the Indo-Pacific Hump-backed dolphin, *Sousa chinensis* (After Hoffmann 1995).

Cape d'Aguilar Marine Reserve

The marine reserve at Cape d'Aguilar on the remotest tip of Hong Kong Island has a sea area of about 18 hectares (Figs. 1 and 3; Plate 1). The fact that it is a peninsula and includes the divided island of Kau Pei Chau, however, gives it an extensive and varied shoreline. Over the short period from 1985 to 1995, there have been twenty-three new species of animals described from its shores. Some of these, such as the small nemertean *Pantionemertes daguilarensis* described from rocky shore crevices and minute arthropod mites from the interstitial habitats of mobile sands in Lobster Bay are inconspicuous. Other species, however, such as the intertidal anemone, *Spheractis cheungae* and the intertidal fish, *Bathygobius hongkongensis*, are numerous, ecologically significant, creatures on not just these but other Hong Kong shores. As an indication of its significance as a marine reserve, Erséus and Diaz (1997) show that 42% (30 of 71 species) of oligochaete worms recorded from Hong Kong occur in its sands. Similarly, 33% (11 of 33 species) of nemertean worms recorded from Hong Kong occur in the reserve, with 5 of the 11 having Cape d'Aguilar as their type locality (Gibson 1997). Finally, there are nine species of tanaid crustaceans recorded from Hong Kong (Bamber and Bird 1997). All of these are new to science and seven have Cape d'Aguilar as their type localities. Morton and Harper (1995) describe the geology, geomorphology and ecology of the Cape d'Aguilar Marine Reserve and provide a bibliography for it.



Plate 1. An aerial view of the Cape d'Aguilar Marine Reserve (Photo supplied by and reproduced with the kind permission of the Director of the Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government).

For a number of pragmatic reasons, such as its remoteness, scenic beauty and vulnerability but, more important, the restricted access to it, the logistic and financial feasibility of affording protection and the desirability of exploiting its potential for research and education, Cape d'Aguilar was considered an ideal marine reserve. Such factors are matched by its geological richness and the wealth and diversity of its habitats and their contained flora and fauna which include a large intertidal coral pool, a unique community in the shell gravel of its shallow bay (Morton and Harper 1997) and two (of three) natural sea arches in Hong Kong. Clark (1997, 1998), describes 22 species of ahermatypic 'soft' corals and 19 species of scleractinian 'hard' corals from the 18 hectare reserve. The presence of the Swire Institute of Marine Science of the University of Hong Kong within the reserve fosters research into and understanding of it and promotes and assists in its management.

Sham Wan, Lamma Island

Sham Wan is a sheltered sandy shore located on the southern coast of Lamma Island. The beach is the only known nesting site in Hong Kong for the Green turtle, *Chelone mydas* (Morton 1999b). There are only sporadic records of turtles nesting on the beach at Sham Wan but, in the summer of 1998, twelve such events were recorded probably, therefore, by three to four females but with, obviously, at least one complementary male offshore. Between 118–141 eggs were laid on each occasion. As females only breed every three years or so, 1998 was an important year in confirming the beach's value as a *Chelone mydas* nesting site. This brought the beach and the turtle, which is an endangered species listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), to the attention of the Hong Kong Government such that the beach at Sham Wan was designated a Site of Special Scientific Interest in June 1999 and on 30 July 1999, the Secretary for Planning, Environment and Lands designated it as a restricted area under the Wild Animals Protection Ordinance (Cap.170) (Fig. 5). The boundary of the restricted area includes only the sandy beach itself, of about 0.5 hectares, and the restriction period is from 1 June to 31 October in any one year. This encompasses the breeding period of the turtle and is intended to limit human disturbance to any nesting females.

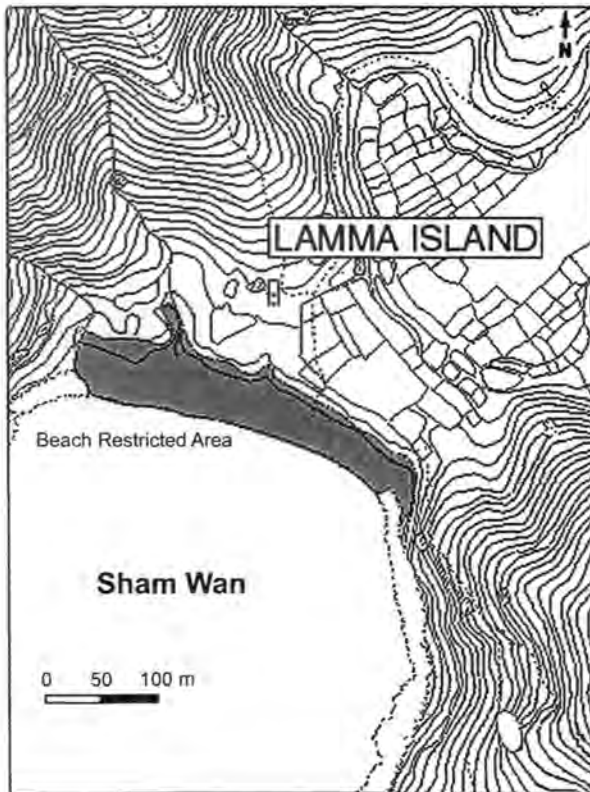


Fig. 5. The Restricted Area beach at Sham Wan, Lamma Island (After Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government).

Other priority areas

Morton (1998, fig. 3) identified other coastal areas of Hong Kong eminently worthy of protection, following an analysis of the 27 local marine Sites of Special Scientific Interest. Three significant locations, in addition to Sham Wan (above), i.e., SSSI No.31 at Pak Nai, the island of Ping Chau in Mirs Bay and the western shores of Lantau Island, including the Soko Islands, were proposed as either marine parks or reserves. To this list should be added Ting Kok mangrove in Tolo Harbour, i.e., SSSI No. 42, as a marine reserve within the broader framework of a Tolo Harbour Marine Park (Morton 1998). It was, however, also suggested by Morton (1988) that virtually all of the eastern waters of Hong Kong and their shores where they are congruent with the Plover Cove and Sai Kung Country Parks should be protected as marine parks.

Pak Nai

Pak Nai on the shores of Deep Bay, Northwest New Territories (Fig. 2) is the only beach remaining in Hong Kong that is a breeding site and juvenile *creche* for two species of horseshoe crabs, i.e., *Tachypleus tridentatus* and *Carcinoscorpius rotundicauda* (Chiu and Morton 1999a). Other beaches which were once a home for the sympatric species have been lost, either through pollution, reclamation or disturbance (Chiu and Morton 1999b) and the adults which live offshore but, like turtles, come ashore to breed each summer are a fisheries product (Morton 1999b) and now considered to be endangered regionally. Since horseshoe crabs may spend the first ten years of their lives on a beach *creche* (Sekiguchi *et al.* 1988), the protection of the sand/mudflats at Pak Nai is crucial to the survival of the species in Hong Kong. In addition, five of Hong Kong's six species of fiddler crabs have been recorded from Pak Nai (Jones and Morton 1994).

Ping Chau

The island of Ping Chau in the northeastern quadrant of Hong Kong is part of the Plover Cove Country Park Extension designated in 1979. Its shores are not, however, protected but are probably the most geologically and ecologically interesting in Hong Kong (Morton and Morton 1983) and the whole, uninhabited, island has been proposed, after Cape d'Aguilar, as eminently worthy of protection as a marine reserve (Morton 1998). In 2000, the Agriculture, Fisheries and Conservation Department of the Hong Kong Government is considering the designation of Ping Chau as a marine park. The proposed sea area of park around the island is 270 hectares and within it are proposed two core areas to the northeast (2.2 hectares) and southeast (5.2 hectares) for the protection of resident reef corals. Although fishing would be allowed in the general waters of the park, it would not be in the core areas. The spectacular cliffs and rock pools on the island's southwestern shore, however, are not, regrettably, proposed for greater protection (Figs.1 and 6) and although they are difficult and, in places, dangerous to access from the land, they are not so from the sea and have, for example, been stripped of sea urchins, *Anthocidaris crassispina* (as still occurs every year, despite marine reserve status, at Cape d'Aguilar) altering the ecologies of the pools. Thus, although the land and surrounding sea have park status, respectively down and up to mean high tide level, and are thereby protected, theoretically, the Ping Chau rock pools will not be in practice. Notwithstanding, the proposal to designate Ping Chau was endorsed by the Executive Council of the Hong Kong Government on 5 May 2000.

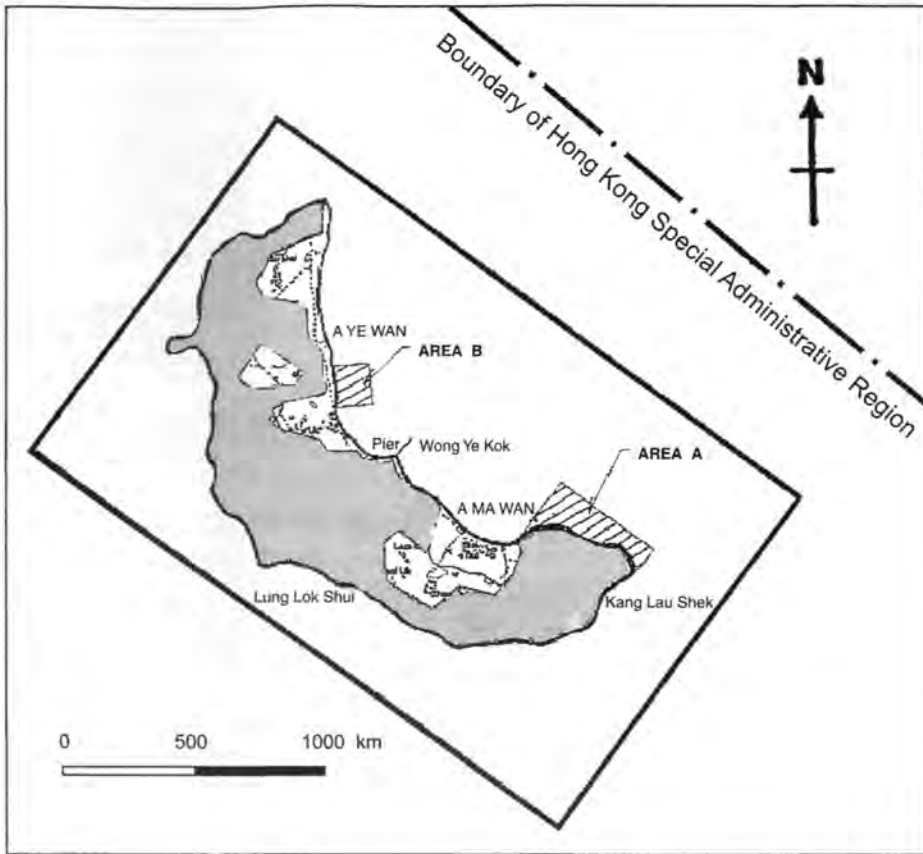


Fig. 6. The proposed Ping Chau Marine Park in the northeastern waters of Mirs Bay (After Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government).

Western Lantau Island

Lantau Island is remote from the urban areas of Hong Kong and has not until quite recently with the opening of the Chek Lap Kok Airport on the north shore in 1998 been subject to despoilage. The island was regarded as one of the last natural refuges of wildlife in Hong Kong. The western end of Lantau is a designated country park. The Hong Kong Government has proposed that the southwestern waters of Lantau Island be designated a marine park, with a boundary from Fan Lau to Lo Kei Wan including the Soko Islands, which possess important archaeological sites. However, the proposal does not include the special ecological sites suggested by Morton (1979, 1998), namely Tong Fuk Mui Wan and Pui O on the south coast. Tong Fuk is the best local representative of a soft shore with moderate shelter from wave fetch by the adjacent headland of Lok Kan Shau, and has not been highly affected by excessive land runoff. Its fauna is different from the typical sandy / muddy shore communities of other Hong Kong beaches. At Pui O there is a fine example of a sand bar enclosing a brackish water

lagoon. This, as well as the associated fauna and flora, is worth conserving (Morton 1979). Five of Hong Kong's six known species of fiddler crabs have been recorded from this beach (Jones and Morton 1994).

There are important small mangrove communities at Yi O, Sha Lo Wan and Sai Tso Wan on the northwestern shore and at Tai O where there are also abandoned salt pans in which, recently, there have been attempts to plant mangroves. There are small sandy beaches at Fan Lau, the most western beach in Hong Kong, and Tai Long Wan. The long beach at Cheung Sha is a magnificent recreational resource for such a park.

On the northern and western side of Lantau is where Indo-Pacific Hump-backed dolphins occur. This is the reason for establishing the Sha Chau and Lung Kwu Chau Marine Park. However, some writers (Hoffmann, 1995; Porter *et al.* 1997; Morton 1998) argue that the small area of the park cannot provide sufficient protection for the dolphins, especially as they are not restricted to Sha Chau and Lung Kwu Chau but also occur to the southwest of Lantau. The proposed Western Lantau Marine Park should therefore help to protect this species too.

MARINE CONSERVATION IN CHINA

China is a signatory to the World Heritage Convention which encourages members to protect their own cultural and natural heritage. China is also a party (as is Hong Kong independently) to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) (1973). Finally, China is a party to the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR) (1971). In addition to Mai Po, China has designated six other RAMSAR Sites, i.e., Zhanlong Marshes, Xianghai Nature Reserve, Niaodao, Dongting Lake, Poyang Lake and Dongzaigang Nature Reserve. Hong Kong, but not China, is also a party to the Convention on Migratory Species (or the Bonn Convention) (1979) so that the Green turtle *Chelone mydas* is protected under this convention at Sham Wan, Lamma Island, but not at the Gankou National Nature Reserve set up to protect it, specifically, in China. Appendix I of this convention also includes seven species of birds which visit Hong Kong, notably Mai Po, on migration, e.g., Dalmatian Pelican and Saunder's Gull.

China has its own laws to protect species and habitats at the State, Province and County levels. A detailed examination of these is beyond the purview of this paper. Briefly, however, in 1998, China promulgated a Law for the Protection of Wild Animals and subsequently formulated a series of related laws, regulations and administrative procedures. These include, for example, Regulations for the Management of Forest and Wildlife Nature Reserves and a List of Key Wild Animals under State Protection (Wildlife and Forest Plants Protection Department 1994). By 1994, 518 forest and wildlife nature reserves had been established in China with a total area of 51.26 million hectares, or 5.34% of the total land area of the country. Among the reserves, 69 are classified as state nature reserves and include the Gankou National Natural Sea Turtle Reserve (Chinese Academy of Forestry 1998). All sea turtles in China are also listed as key wild animals and the Green turtle, *Chelone mydas*, is classified as a Class 1 Protected Species (Chinese Academy of Forestry 1998). Many marine organisms are protected species, including Horseshoe crabs, but they can still be found for sale in fish markets and restaurants, for example, Xiamen and Hong Kong.

In order to conserve sea turtles, however, in 1998 the Guangdong Provincial Government integrated the relevant state law and regulations and the provincial legislation into the Guangdong Province Sea Turtle Conservation Ordinance. This ordinance states that all sea turtles are key wild animals under state protection. The establishment, management and scientific research of the Gankou National Nature Reserve are empowered by this ordinance. Moreover, the catching, killing, carrying, keeping, buying or selling of sea turtles or their eggs are illegal. Permits must be obtained if sea turtles, or their eggs, are to be collected for scientific research or any other use. Contravention of this ordinance is liable on conviction to a fine of ¥1000 for each turtle and ¥20 for each egg. Second or subsequent convictions will be subjected to three times the original fine. Unauthorized entry into the Gankou reserve or violation of any regulations inside it shall be liable on conviction to a fine of between ¥100 to ¥500.

In November 1988, the State Oceanic Administration was made responsible for designating and managing marine nature reserves in China at the State and Province levels. Five marine nature reserves, including Changli Golden Beach, Shankou Mangrove Ecosystem and Dazhou Island Marine Ecosystem Nature Reserve, were selected, investigated and nominated for designation by local marine administrations and relevant departments in 1989 and approved by the State Council in September 1990. In November 1991, the State Oceanic Administration set up a national marine nature reserve review board which identified, assessed and recommended to the State Council a group of national marine nature reserves for approval. In October 1992, a second group of national marine nature reserves, including Tianjin Palaeocoast and Wetland and Jinjiang Ancient Forest, was approved by the State Oceanic Administration. Between 1989 and 1992, a number of other regional marine nature reserves were designated and approved by local governments (Anonymous 1993). By 1992 and since 1988, China had established 48 marine nature reserves (Table 1) (Yan 1992). There were in 1992, nine national, twenty

Table 1

A list of marine reserves in China (by Province) and level of protection (National, Provincial, Municipal and County) After: Nature Conservation Department, National Environmental Protection Department, China 1992.

Province	National	Provincial	Municipal	County
Tianjing	—	1	—	—
Hebei	1	—	—	—
Liaoning	2	—	2	—
Shanghai	—	2	—	1
Zhe Jiang	1	—	—	—
Fujian	—	2	1	1
Shandong	—	1	1	2
Guangdong	1	5	1	1
Guangxi	1	3	—	—
Hainan	3	6	3	5
Total	9	20	8	11

provincial, eight municipal and eleven county marine nature reserves. Of these, the State Oceanic Administration (Anonymous 1993) has designated seven national, three provincial and four municipal marine nature reserves. Other Government agencies are responsible for the remainder. Huang (1994) inventories the major characteristics of China's marine flora and fauna.

The State Oceanic Administration's '*Action Plan for Marine Diversity Protection in China*' (Anonymous no date) called for the establishment of five types of marine reserve (Huang *et al.* 1995), as follows:

- Three Marine Conservation Areas, that is, the Miaodao Archipelago, Nan-ao Island and Weizhoudao and Xieyang Island.
- Six Coastal Wetland Marine Conservation Areas, including: Liaodong Bay, West Bohai Bay, Chongmin Dongtan in the Changjiang Estuary and Quanzhou Bay.
- Four Coral Reef Conservation Areas, including: Dongdao Island in the Xisha Islands group, Dongshan Island and Nansha Yongshujiao, all in the South China Sea.
- Twelve Mangrove Conservation Areas, including: the Beichang Estuary to -Pearl Harbour in Guangxi Province, Zhangjiang in Fujian Province and Qingzhou Bay in Guangxi Province.
- Eighteen Marine Conservation Areas for Rare and Endangered Species, for example, the Mangrove frog (*Rana cancrivora*) in Guangxi, the Lancelet (*Branchiostoma belcheri*) in Xiamen, Fujian Province, the Horseshoe crab (*Tachypleus tridentatus*) on Pingtau Island, Fujian Province, the True seal (*Phoca largha*) in Liaodong Bay and the Dugong (*Dugong dugong*) in West Yangjiang and Hainan, Guangdong Province. In addition, priority is to be given to the protection of all coral reefs, mangroves and all marine species classified as endangered by the State.

China's Biodiversity: A Country Study (Anonymous 1998), however, states that there are 25 marine and coastal ecosystem nature reserves with an area of 378,000 hectares plus 34 nature reserves for wildlife habitat, making a total of 59 marine reserves with a total area of 1.292 million hectares or about 0.3% of China's maritime waters (4.73 million km²). These are not, however, elaborated upon.

Marine reserves in Guangdong Province

There are eight designated marine reserves in Guangdong Province (Table 1). Of these, two are of importance in relation to their proximity to Hong Kong, that is, the Neilingding Island-Futien National Nature Reserve and the Huidong Gankou National Nature Reserve.

Futien Nature Reserve

Opposite Mai Po on the northern shore of Deep Bay, in China, is the Futien Nature Reserve which is of a similar size, that is, ~ 350 hectares, but much longer and narrower than the former (Fig. 2). As at Mai Po, six species of mangrove trees occur here and, as at Mai Po, there are landward fish and prawn ponds. Such ponds make up half of the reserve area and, inland, there is a 200 m buffer strip of agricultural land. An attempt to diversify the mangrove by introducing non-local, tropical species from Hainan failed,

attesting to the area's subtropical status. Futien is a national reserve, established in 1988 and administratively linked to the nearby Neilingding Island Nature Reserve for the Macaque, *Macaca mulatta*.

At both Mai Po and Futien, mangroves are relatively short, reaching a maximum height of only 5 m. In both locations, disturbance to the landward section of the mangrove has halted succession, so that only a pioneer community of *Kandelia candel*, *Aegiceras corniculatus* and *Avicennia marina* is typically present. Due to the growth of Shenzhen Economic Zone around Futien and urban developments around Mai Po, there are strong pressures on the integrity of both reserves (Young and Melville 1993). The Mai Po and Futien reserves are especially concerned with the protection of migrating waterbirds and, in this context, although China is not a signatory to the Convention on Migratory Species, it has signed agreements with Japan and Australia for the protection of migrating birds and their habitats. At nine bird banding stations along the Chinese coast, 62,755 birds representing 186 species have been recovered (Huang *et al.* 1995).

Huidong Gankou Nature Reserve

Gankou Nature Reserve for Sea Turtles based around Nine Dragon's Beach in Gaoyao County, Guangdong Province, is located at the southeastern tip of the Dapeng Peninsula which separates Daya Bay to the east, in China, from Mirs Bay to the west, in Hong Kong (Fig. 7). The 1000 m long Nine Dragon's Beach, with an area of 80 hectares, was established as a county-level protected area in 1985 and upgraded to a provincial reserve in 1987. It was established as a national reserve in 1992, being the only location on the mainland coast of China (18,000 km) where female turtles (except, now, Sham Wan, Lamma Island), notably the Green turtle, *Chelone mydas*, come ashore to lay eggs. In 1993, together with six other state nature reserves, Gankou was admitted to the Man and the Biosphere Reserve Network (World Conservation Monitoring Centre 1994).

Each year, from June to October, approximately 100 females come ashore to dig nests and lay eggs. By 1992, staff at the reserve had tagged over 400 females and over 30,000 hatchlings had been released into the sea. Each female lays between 3 and 7 clutches in a season, returning between every 13 to 17 days in cycles of approximately three years. Staff at the reserve dig up the laid eggs and hatch them in artificial boxes, controlling the temperature to between 24 and 27°C and thereby increasing the hatching success rate from 78% naturally to 93% and increasing the male: female sex ratio to 1: 7 (Morton 1992b).

Nine Dragon's beach is a near-natural aeolian beach capped by vegetated dunes and must have great value not only to China, but also for all shores bordering the South China Sea as a turtle nesting beach. Such beaches, virtually everywhere, have all the qualities necessary for tourism and pressures for its development for such a purpose must grow.

CURRENT STATUS OF CO-OPERATION BETWEEN HONG KONG AND GUANGDONG PROVINCE RELATED TO CONSERVATION

Cross-border marine conservation-related disciplines, such as water quality management and cross-border infrastructure assessment, have only been addressed in the last decade between Hong Kong and Guangdong Province authorities. Today, and subsequent to 1

July 1997, such talks constitute an official working partnership between two regional governments.

The Hong Kong-Guangdong Environmental Protection Liaison Group

In 1979, the Hong Kong Environmental Protection Department initiated contacts with the Guangdong authorities in view of the rapid economic development taking place in both Hong Kong and the province. The objective was to establish channels of communication and to provide the basis for joint action in tackling cross-border environmental problems. This led to the first visit of a delegation from the Guangdong Environmental Protection Bureau to Hong Kong in January 1983.

In July 1990, the Hong Kong Government and the Guangdong Provincial Government set up an official working body, the Hong Kong-Guangdong Environmental Protection Liaison Group (EPLG). The aims of this group are to 'enhance the co-operation and co-ordination between Hong Kong and Guangdong on environmental management and pollution control efforts in areas of mutual concern'. Prior to 1998, the EPLG only met once a year. The EPLG met three times in 1988, this closer working relationship resulting from Hong Kong becoming a Special Administrative Region of China after reunification on 1 July 1997.

A Technical Sub-Group (TSG) of the EPLG was formed in 1990. It was originally set up to consider common standards and objectives for the environmental protection of Deep Bay's ecosystem, 'in particular the general development of the area and the beneficial uses which could be sustained'. In recent years, the technical sub-group has taken up much broader responsibilities. Apart from supporting the Deep Bay Regional Control Strategy Study, it also helps to implement the EPLG's annual work programme. Apart from the technical sub-group, two special study groups have also been formed to look at specific issues. A study group examining the conservation of the Chinese White dolphin was set up in 1997 with the objective of enhancing co-operation related to the protection and conservation of the species. A second study group focusses on air quality in the Pearl River Delta and was formed in February 1998.

The Liaison Group and its technical sub-groups have discussed a wide range of environmental issues. Those related to marine conservation are as follows. Deep Bay was afforded the highest priority in terms of requiring protective conservation action by both Guangdong and Hong Kong. In 1992, an Environmental Management and Action Plan was formulated to protect the marine water quality of Deep Bay. Under the action plan, the Liaison Group completed (in 1995) a joint monitoring study of air and water quality. The Deep Bay Regional Control Strategy Study assessed the bay's dispersive and self-assimilative capacity and established a water quality model which was also completed in 1998. The Deep Bay Action Plan was reviewed in 1998 and auditing is carried out every six months to ensure it is implemented.

A joint study on the environmental protection of Mirs Bay (Stage 1) was completed in 1997. The study identified various major environmental issues which affect the ecological importance of Mirs Bay. The impacts include Yantian Port in northern Mirs Bay, future increases in population, recreational and industrial developments along the bay's coastline and economic and environmental concerns associated with fish culture zones. The study set out a joint environmental management strategy and action plan for Mirs Bay including environmental assessment and auditing, sewage treatment and

pollution and development control. Regular audits, carried out every six months, are ongoing to monitor the effectiveness of the Action Plan. Discussion started on the development of a Mirs Bay Water Quality Regional Control Strategy in November 1998.

With the assistance of the State Oceanic Administration (SOA) in 1998, Hong Kong's Environmental Protection Department (EPD) completed field surveys collecting information on water quality and pollution loads throughout the Pearl River Estuary and China's territorial waters west, south and east of Hong Kong. In 1998, the EPD also joined the SOA, South China Sea Branch, to conduct China's Second Marine Pollution Baseline Survey and the National Marine Environmental Monitoring Network. Although co-operation in terms of research into water quality in the Pearl River Delta has been carried out, there are not, as yet, management plans for the estuary.

At the meeting of EPLG held in December 1996, members agreed to establish a study group for the conservation of the Chinese White dolphin under its technical subgroup. The objectives of the study group were:

- Exchanging and reviewing existing information on the Chinese White dolphin in Hong Kong and the Pearl River Estuary.
- Considering and identifying further studies on the dolphin.
- Considering and developing a conservation plan for the dolphin in Hong Kong and the Pearl River Estuary.

Meetings of the study group are held once a year, either in Hong Kong or Guangdong. At the meeting, papers on various aspects of the Chinese White dolphin are presented by both parties. There has been co-operation to produce a Chinese White dolphin poster and save a trapped dolphin in Huadu. Both sides also agreed to further support a Chinese White dolphin study of the Pearl River Estuary and to inform each other of all oil spill incidents. Exchanging tissue samples collected from stranded dolphins was also considered.

At the 10th meeting of EPLG held in November 1998, members agreed to set up the Hong Kong-Guangdong Fisheries Resources Environmental Protection Group to co-operate in fisheries resources management, aquaculture and red tide monitoring.

In addition to co-operation related to Chinese White dolphin conservation under the EPLG, the Agriculture, Fisheries and Conservation Department (AFCD) of the Hong Kong Government also has some cross-boundary co-operation in relation to marine conservation with the Chinese authorities. The co-operation between AFCD and the Huidong Gankou National Nature Reserve authorities is the best example of this. Beginning in 1997, Green turtle nesting data for Sham Wan, Lamma Island, Hong Kong and Gankou, Guangdong, have been exchanged by the two authorities. Other information on such topics as turtle by-catch and stranding records, have also been exchanged.

DISCUSSION

Hong Kong's Marine Parks Ordinance aims at:

- Protecting, restoring and enhancing the marine life in and the environment of any marine park or reserve.
- Managing the resources of marine parks to meet the needs and aspirations of present and future generations.

- Facilitating recreational activities in marine parks.
- Providing opportunities for educational and scientific studies upon local marine life in the environment of marine parks and reserves.

Management of the marine parks and reserves is the responsibility of the Country and Marine Parks Authority (Director of the Agriculture, Fisheries and Conservation Department of the Hong Kong Government), with advice from the Country and Marine Parks Board and, in turn, its Marine Parks and Reserves Committee.

It was not until 1993, however, that there was official support for legislation to conserve the marine environment in Hong Kong and, thus, protect important elements of its coastal heritage. Hong Kong is, however, broadly speaking, in step with China and its marine conservation policy and the Marine Parks Ordinance allows for the designation of local sites as marine parks, reserves and restricted areas, as described above. The designation of the Mai Po Marshes as a RAMSAR site in 1995 reflects the internationally recognised importance of the area; other marine parks and the reserve at Cape d'Aguiar have also been proposed through scientific consensus. The marine park at Lung Kwu Chau and Sha Chau for *Sousa chinensis* was, however, largely designated as a knee-jerk response to pressures from conservationists and simple desktop research (Würsig 1995) and will probably not work as the dolphin population is already considered to be non-viable and threats to the habitat can only increase (Hoffmann 1995; Porter *et al.* 1997), as will be discussed.

Inspection of the maps of Hong Kong presented here, however, illustrate one other point: all the sites, both designated and proposed as marine protected areas, are located at the periphery of its territorial waters and coasts.

From a biological point of view, there is a substantial volume of literature on the impact of pollution, in its broadest sense, upon Hong Kong's marine life, especially with regard to coastal communities and this subject has been reviewed by Wu (1988) and Morton (1980, 1987, 1989, 1992c, 1996b). Such pollution has resulted from poor planning with regard to the proper disposal of domestic sewage, agricultural wastes and industrial effluents as Hong Kong has grown and with the creation by reclamation of land for its physical development. The areas of China around Hong Kong, specifically within Guangdong Province, are also undergoing fast economic development and much less has been written, at least in the non-governmental literature available, on the impacts of this upon the marine communities of waters external to those of Hong Kong and upon those of the territory itself. The hydrographic impact of the Pearl River upon the western waters of Hong Kong is reasonably well understood (Kot and Hu 1996). On the flooding tide, the polluted northwestern waters of Hong Kong are pushed up into the Pearl River estuary (and into Deep Bay) (Fig. 7A) whereas on the ebbing tide, the less saline waters of the Pearl exert their influence in the reverse direction (Fig. 7B). Less well understood, however, is the impact upon Hong Kong waters of the pollution load carried in the Pearl River, although Broom and Ng (1996) discuss this briefly. Blackmore and Chan (1998) show how levels of heavy metal bioavailabilities have declined in Hong Kong over the last ten years, except in the west, e.g., Cd in barnacles = $6.49 \mu\text{g}\cdot\text{g}^{-1}$. This is thought to reflect the move of polluting industries from Hong Kong to China, where land and labour are cheaper and anti-pollution controls laxer, over this period, and the return of metals from the discharges relocated industries in the Pearl River outflow.

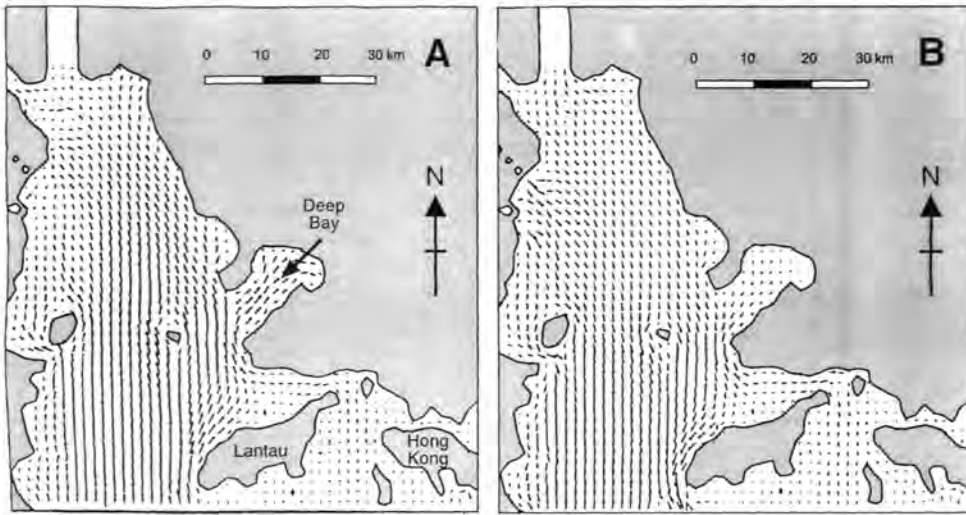


Fig. 7. The distribution of the simulated residual current vector field in the Pearl River on A, flooding and B, ebbing tides (After Kot and Hu 1996).

Two of Hong Kong's marine conservation areas are, however, in northwestern waters under the influence of the Pearl River, notably the Sha Chau/Lung Kwu Chau Marine Park for the Indo-Pacific Hump-backed dolphin and the Mai Po Marshes Nature Reserve in Deep Bay, which is essentially a tributary of the Pearl. Kot and Hu (1996) show how the flow of the Pearl impacts directly the Sha Chau/Lung Kwu Chau Marine Park and also floods into Deep Bay. This is especially important for the population of Indo-Pacific Hump-backed dolphin (*Sousa chinensis*) that is resident in this area as changes in the outflow of the Pearl River and the front between estuarine and marine waters influence the animal's distribution in these western waters (Parsons 1998). Thus, although concentration of heavy metals in western waters, e.g., except for Cd in barnacles (Blackmore and Chan 1998) and Pb and Hg in fish (Parsons 1998), DDT concentrations in the tissues of the resident Indo-Pacific Hump-backed dolphins are amongst the highest in the world, i.e., $\sim 100 \mu\text{g}\cdot\text{g}^{-1}$ SDDT wet weight (Parsons *et al.* 1998).

Li and Shing (1987) have investigated residual current flows in Deep Bay in more detail and shown how the pattern of circulation differs over the tidal regime but essentially is in a clockwise direction on a rising tide (Fig. 8). This means that water enters the bay to the north, flows along the northern shore passing major developments here in China, such as the port of Shekou and the sprawl of the Shenzhen Special Economic Zone and flows out to the south, past Mai Po, having picked up and transported pollutants on its route and been added to be the grossly polluted Shenzhen River separating Hong Kong from China and then flows past the equally polluted Yuen Long Creek. Mai Po is, thus, impacted by both local and China-generated sources of pollution.

The loss of coastal habitats due to the construction of the new airport at Chek Lap Kok (completed in 1998), increasing marine traffic, toxic wastes in nearby contaminated mud pits, dredging of marine fill and the discharge of inadequately treated sewage from

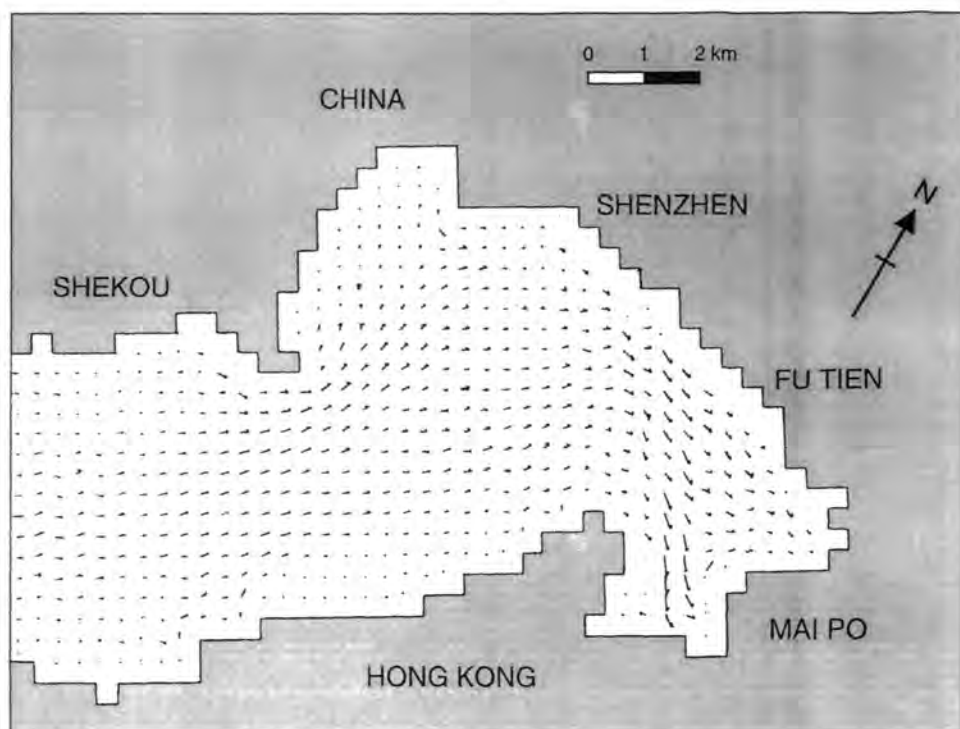


Fig. 8. The distribution of the simulated residual current vector field in Deep Bay, Hong Kong on a rising tide (After Li and Shing 1987).

three major outfalls, have collectively acted to degrade the waters off North Lantau. The degradation of the environment and over-fishing are thought to have reduced the amount of food available to the resident Indo-Pacific Hump-backed dolphins and exposed them to physical harm, for example, boat propellers and disease.

Prior to the 1990s, there were few records of stranded dolphins. In 1994, however, there were nine dolphin corpses reported from shores around the Sha Chau / Lung Kwu Chau Marine Park designated to protect them; there were seven births into the population and two calves died. In 1995, ten animals were stranded, four calves were born, one of which died. All nine calves born in 1996 died and a total of 15 strandings were recorded. In 1997, ten individuals were stranded of which five were calves. In 1998, there were six strandings, including one pregnant female, and one was a calf. In 1999, there were eleven strandings of which seven were calves (L.J. Porter personal communication). In 2000, there were six strandings (Fig. 9). This figure also illustrates the dramatic increase that has occurred in the reportings of stranded *Sousa chinensis* over the 25 years since 1974. Although this may, in part, be due to greater public awareness of the need to report such events, the elevated levels of the 1990s suggest a profounder problem with the dolphins.

Parsons and Chan (1998) believe that organochlorine (DDT) residues may, at least in part, be responsible for the deaths, levels being especially high in milk (3740–7500

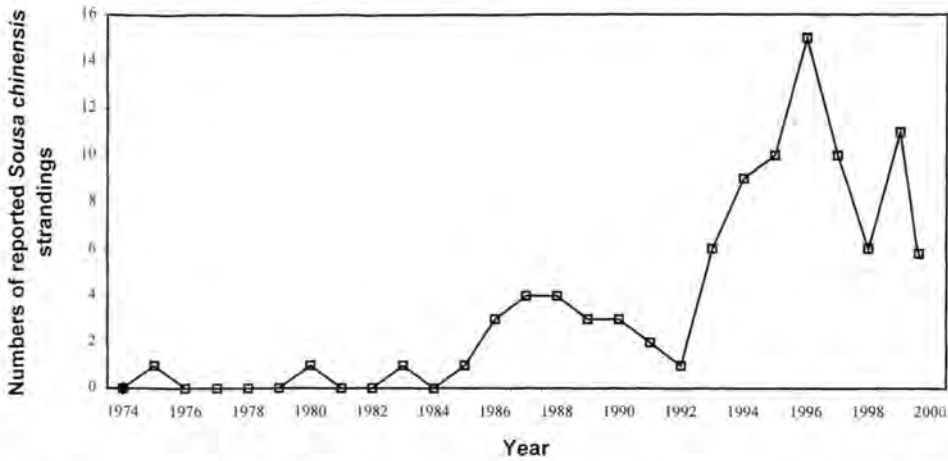


Fig. 9. Reports of *Sousa chinensis* strandings from Hong Kong's territorial waters (After Porter *et al.* 1997 and the Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government).

$\mu\text{g}\cdot\text{g}^{-1}$ ΣDDT). The fact that strandings are still occurring and most calves born in any one year are a significant element of these annual figures is disturbing. A feasibility study of the marine park, moreover, concluded that it would not be viable in the long-term and that with the current rate of local extirpation (estimated at $\sim 20\%$ per annum), such a designation was pointless (Hoffmann 1995), unless the area scheduled for protection was increased and stricter regulations introduced. Porter *et al.* (1997) and Morton (1998) argue that the park should be extended greatly and both provide maps to illustrate how (Fig. 10) and, in particular, incorporate into the broader proposal for a marine park, the ecologically sensitive coastal areas of southwestern Lantau and the Soko Islands.

Hong Kong's two other marine parks at Yan Chau Tong/Lai Chi Wo and Hoi Ha Wan in the northeast are located on the western bank of Mirs Bay which, forms the border between China and Hong Kong. Hoi Ha Wan is influenced by polluted water emanating from Tolo Harbour (Morton 1987) where it has destroyed many of the resident corals (Scott and Cope 1990). Zou *et al.* (1992), Collinson (1997) and McCorry and Blackmore (2000) all demonstrate that the corals are still declining in Hoi Ha despite designation of the marine park. Wen and Huang (1995) have, moreover, made a study of the residual current flows within Mirs Bay and shown how the circulation is in an anti-clockwise direction, moving up the eastern coast of Mirs Bay, in China's territorial waters, across the top and then down the western side of the bay, that is, Hong Kong, past the two parks of Yan Chau Tong/Li Chi Wo and Hoi Ha Wan and down the more typically-considered cleaner coastline of Hong Kong's eastern waters (Fig. 11). The Chinese Government has built a container port on the northern shore of Mirs Bay at Yan Tian. Along the eastern shores of Mirs Bay, large factories, including one for automobiles, and an oil refinery are proposed, the latter adjacent to the remotest Hong Kong island and proposed marine park of Ping Chau with its remarkable sedimentary geology, coastal geomorphology and marine life (Morton and Morton 1983). The land

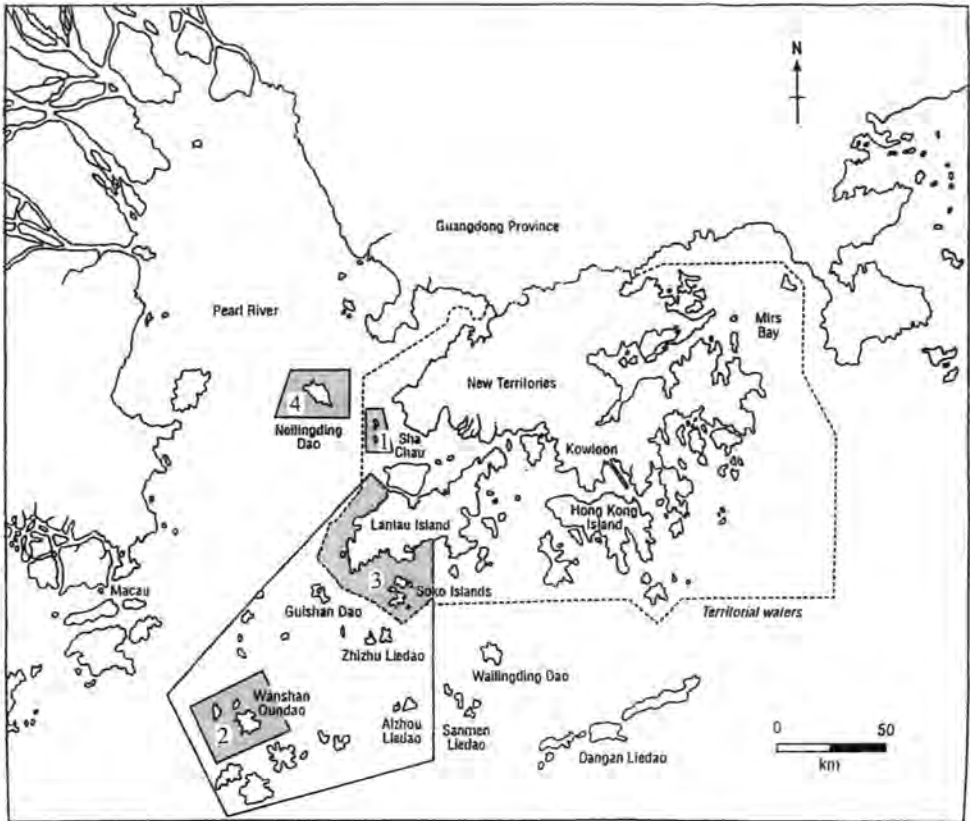


Fig. 10. Proposed scheme of marine park and reserve areas for *Sousa chinensis* within Hong Kong's territorial waters and the Pearl River Estuary. 1, Existing marine park, Hong Kong SAR Government. 2, Proposed marine protected area, Guangdong Authorities. 3, Proposed marine reserve in the Hong Kong SAR and, outlined, a broader protected area encompassing both this and the Guangdong Authority's proposed protected area. 4, Proposed marine reserve in Guangdong waters, based on regular sightings of dolphins in this area by fisherman and its proximity to Hong Kong's existing marine park. (After Porter *et al.* 1997).

area of Ping Chau and some other islands in Mirs Bay are already designated as an extension of the Plover Cove Country Park but their coastal waters also possess high value as a marine park, even a reserve. Effluents from mainland developments around Ping Chau will, according to the study of Wen and Huang (1995), be transported in a northerly and westerly direction into Hong Kong's waters and add to the impact upon, notably, Hoi Ha Wan.

In reality, water quality inside Mirs Bay and, thus, Hoi Ha Wan Marine Park is already poor. Reduced oxygen tensions and seabed eutrophication, due to water column stratification, have been shown to occur each summer in Tolo Harbour, Hong Kong leading to red tides and mass mortalities of the benthos (Wu 1982) followed by recolonisation in the winter as the water column is re-mixed. Such events may be partly

natural because of Hong Kong's complex hydrography, mediated by high precipitation in summer. In 1994, an extreme hypoxia event occurred in the northeastern waters of Hong Kong, killing much of the subtidal benthos over an area of 100 km² and, notably, in Hoi Ha Wan (Collinson 1997). This was attributed by Wilson and Wong (1995) to an extremely unusual event linked to high water discharge from the Pearl River, following the heaviest rainfall for 100 years. The discharge resulted in a compensatory flow of cool, highly saline, bottom water which penetrated Mirs Bay causing stratification and subsequent deoxygenation of the waters up to -2 m C.D. and the death of many animals. When summer rains flush accumulated organic wastes from streams and nullahs (drainage channels) such events are probably exacerbated by accumulated pollutants (Wu 1982; 1988) and Morton (1996) suggested that hypoxia and even anoxia events have been reported from Tolo Harbour for decades and that although the extreme 1994 event may have been, in part, natural, the former richness of, for example, Hong Kong's corals could not have been sustained if it occurred regularly and, thus, that pollution is a significant factor contributing to and exacerbating its effects.

The study by Wen and Huang (1995) of water circulation in Mirs Bay assessed such pollution impacts and suggested remedial measures. They noted that a strong current sweeps from west to east across the entrance to Mirs Bay and argued that effluents should not be discharged into the bay but piped out of it into this current and thus dispersed. Unfortunately, this would take them to the Huidong Gankou Nature Reserve for the Green turtle, *Chelone mydas*. In relation to the turtle, moreover, the recently designated restricted beach area of Sham Wan on Lamma Island may still yet be under threat because it is from here that the long sewage outfall pipe which is planned for Stage II of Hong Kong's Strategic Sewage Disposal Scheme (SSDS) is scheduled to enter the southern waters to its discharge point.

In a study of tidal flows around Hong Kong Island, Ip (1996) notes that residual currents sweep across the entrance to Mirs Bay in a westward direction (Fig. 12), in contrast to the earlier defined eastward flow (Fig. 11) (Wen and Huang 1996). Such an apparent contradiction waits to be resolved but probably relates to the timing of the two sets of observations. As the ocean currents influencing the southern coast of China change seasonally, that is, eastwards in summer, westwards in winter, so will the prevailing flow. It is thus likely that in summer the Huidong Gankou Nature Reserve would be affected whereas in winter such discharges would influence most profoundly the Cape d'Aguilar Marine Reserve on the southeastern tip of Hong Kong Island and the virtually untouched, outermost, island groups of the Ninepins in the east and of Beaufort, Po Toi, Sun Kong and Waglan in the southeast.

This latter local poor understanding of how changing current flows can variably influence marine protected areas highlights the essence of the problem: authorities in China and Hong Kong are proposing developments and undertaking research which may be used to ameliorate pollution impacts largely in ignorance, at least at the scientific level, of not only what the other is attempting to achieve but without a clear view of how both are affecting each other anyway. Hong Kong's Territorial Development Strategy Review (Planning Department 1995) had six objectives, the third of which was 'To conserve and enhance significant landscape and ecological attributes and important heritage features.' The review identifies key issues for Hong Kong's future in relation to those of China, notably adjacent Guangdong Province. Major infrastructural developments in both places are described in broad terms; airports, ports, railways, roads,

water and electricity supplies, new cities and how the development of the two places can be integrated. Conversely, however, environmental and conservation issues are only discussed in terms of Hong Kong — a clear indication of where regional priorities lie.

Pollution, non-regulated fishing, development, reclamation, dumping and dredging have had powerful adverse impacts upon the water quality and coastal marine life of Hong Kong and what is now surviving, is so at the edge. That Mai Po is threatened by pollution and encroaching urban developments (Irving and Morton 1988), that the marine park for the dolphin *Sousa chinensis* is considered non-viable (Hoffmann 1995), that all the colonies of the coral *Porites lobata* died within the Cape d'Aguilar Marine Reserve just prior to its designation (Clark 1995) and that the corals of Hoi Ha Wan are still in decline (Zou *et al.* 1992; Collinson 1997; McCorry and Cumming 1999), suggest that such conservation measures may be already too late. Cumming and McCorry (1998) most recently reported upon outbreaks of the gastropod *Drupella rugosa* feeding on Hong Kong's corals, although Morton and Blackmore (2000) argue that these are natural.

Almost 50% of Hong Kong's total land area receives some form of protection and this, in a regional context, is more than adequate. The coastal zone and shallow continental shelf waters, however, with a level of 1% protection, are less than adequately protected and, for example, unlike the country parks, marine parks are poorly managed and still fished commercially. In contrast, tree planting, fire protection and litter collection are features of country park management but their equivalents are not in the sea, that is, there is little or no marine habitat restoration or remediation.

Hong Kong is surrounded by the Shenzhen Special Economic Zone within the southern Chinese Province of Guangdong and which is, itself, undergoing massive and rapid development, so that the pressures upon Hong Kong's conservation areas are both from within and without. It is, therefore, crucial that Hong Kong's conservation policy outlined by the Planning Department (1995) be linked to that of China and that cross-border co-operation be increased significantly, especially in the field of coastal zone management for marine conservation, to attempt to protect the marine parks and reserves of southern China and try to ensure survival of representative habitats, species and genetic diversity.

It is finally important that the present imperative of treating country parks separately (and differently) from marine parks, even where they are congruent, needs to be re-appraised so that integration of land and sea as a continuum is at last recognised and, with greater cross-border consultation and co-operation, what is left coastally in Hong Kong may survive.

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