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Protecting Hong Kong's marine biodiversity: present proposals, future challenges

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Summary

Pollution from many sources, over-fishing and the rapid development of Hong Kong have had powerful, adverse, impacts upon local marine life reducing it to but a shadow of what it once was. This paper describes Hong Kong's newly enacted Marine Parks Ordinance Chapter 37 1995, discusses the existing situation with regard to the designation of marine parks and reserves, and describes the special features of each one. It argues that a territory-wide strategy will have to be implemented if representative intertidal and coastal water communities are to survive. 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. The threats to them are too great. Conservation legislation and coastal planning exercises should also be integrated with those of China as soon as possible, especially for areas of coastline surrounding Hong Kong. This is because development within southern China is proceeding at such a pace that Hong Kong's protected areas are now being threatened by external factors as well as internal ones.

Keywords: Marine Parks Ordinance, Proposed Parks & Reserves, Pollution, Fishing & Development Impacts, Southern China.

Introduction

Hong Kong is located on the southern coast of China, on the eastern bank of the Pearl River. The river is some 120 km wide at its mouth, has the Portuguese colony of Macau on the western bank, and drains a vast area (442 440 km^2) of China. With an annual water flow of $308 \times 10^9 m^3$, carrying 86 million tonnes of sediment and organic particulates (Shen 1983), the Pearl River has profound physical, ecological and economic impacts on Hong Kong.

Hong Kong is an economic miracle ranking as the world's eighth largest trading economy, despite a mere 1084 km^2 of land, few natural resources and a population of 6.1 million. Hong Kong is strategically important for its port, Victoria Harbour, which is the *raison d'etre* for the territory; around it have grown the cities of Victoria on Hong Kong Island, and Kowloon on the mainland peninsula. Formerly, most of Hong Kong's population lived in these cities but in the 1970s the decision was made to build new ones in the hitherto rural New Territories so that, today, the human population is more dispersed. In the absence of appropriate planning for sewage and other waste discharges in the New Territories, which now house 45% of the population, there has been wide-scale destruction of former natural coastal and inshore communities. The best example of this is Tolo Harbour on the shores of which two cities, Shatin and Tai Po, have been built to accommodate one million people. In the absence of adequate sewage treatment facilities, the once pristine, coral-fringed harbour has been grossly polluted and resident marine communities lost (Scott & Cope 1990; Shin 1990; Taylor & Shin 1990).

Land is valuable in Hong Kong and is highly managed. Approximately 20% of the land area is urban, 5% is agricultural and 75% is under broad-leaf woodland, grass and scrub because of the steep upland terrain. Hong Kong is essentially a mountainous intrusive-granitic and extrusive-volcanic block that rises naturally from the sea (80% of the coastline) to heights of almost 1000 m. The coastline is also deeply incised and there are 235 islands. This is because of an approximate 10 m rise in sea-level following the end of the last Ice Age. In the north west, the 5000 ha Yuen Long Plain was the largest area of agricultural land, including fish ponds, but it is also now being built upon. The undeveloped uplands of Hong Kong were important for water catchment. Most water is now provided by China, however, and such lands, comprising about 41% of the total area, are Country Parks. There are 21 of these, 14 Special Areas and 58 Sites of Special Scientific Interest. Of the latter, 32 are coastal (Fig. 1).

The territorial waters of Hong Kong comprise 1827 km^2, or approximately 1.5 times that of the land area. 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 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 compromised hydrography and which accommodates the largest urban centres. Because of poor planning, virtually all of Hong Kong's urban sewage and industrial effluents enter the waters of this zone 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 local importance. This is especially important from an ecological point of view because coastal reclamation for development, dredging for marine fill, intensive and highly destructive fishing practices, and pollution, have combined in near-total destruction of what was once a marvel of marine biodiversity.

Twenty years ago I published a paper entitled 'The Hong Kong sea-shore – an environment in crisis' (Morton 1976) which had been read at the 13th Pacific Science Congress, Vancouver, Canada, in 1975. This paper, read at the 18th Congress in 1995 in Beijing, China, reviews progress towards marine conservation in Hong Kong.

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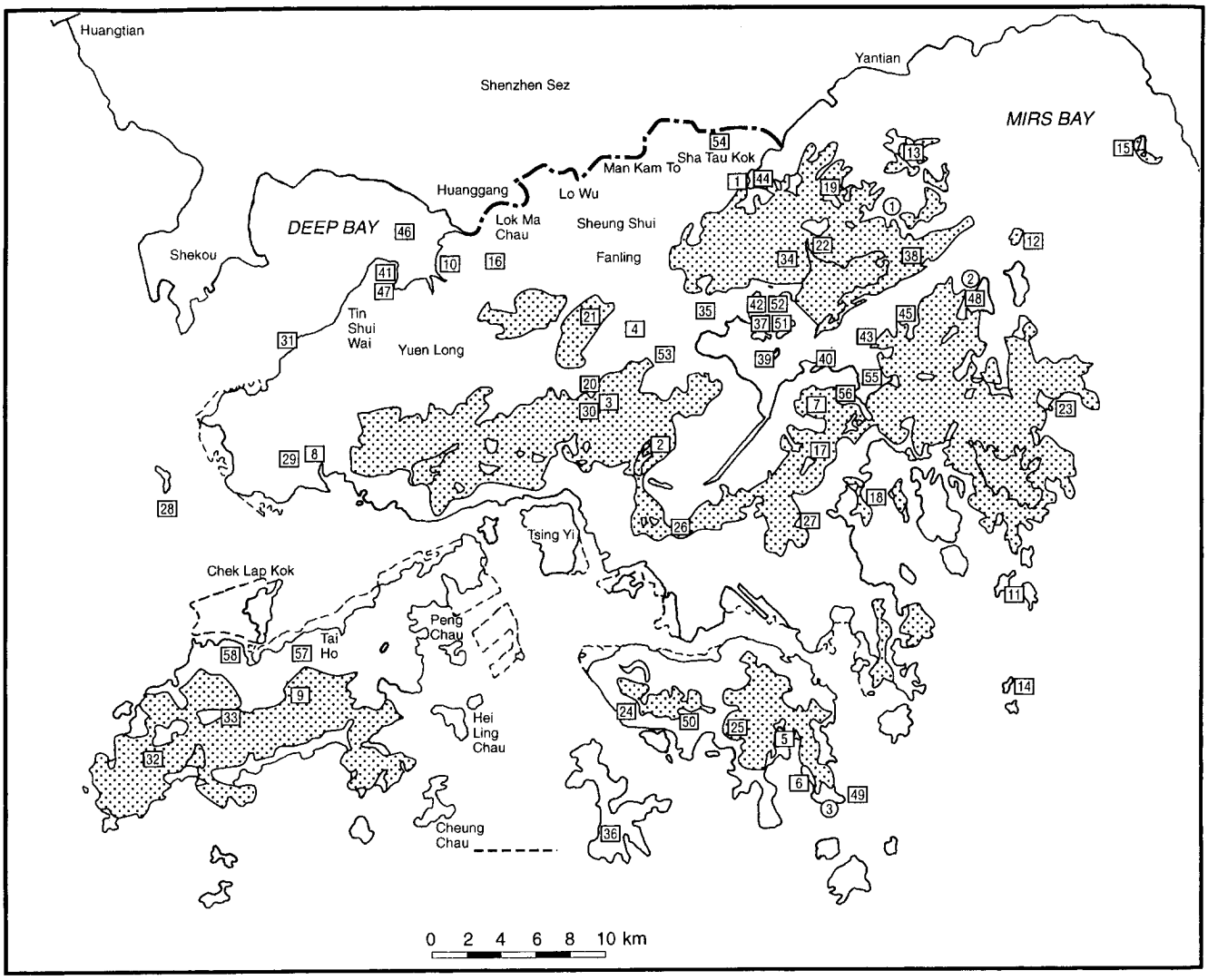

Figure 1 A map of Hong Kong and its inshore waters showing the locations of Country Parks and Special Areas (stippled areas), Sites of Special Scientific Interest (numbers, 1–58, in squares) and Proposed Marine Parks and Reserves (numbers, 1–3, in circles). Source: Agriculture and Fisheries Department, Hong Kong Government.

Hong Kong's coastal environment

For such a small area, the deeply-incised coastline of Hong Kong is long, amounting to approximately 800 km. There is great habitat diversity. 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 114° E, Hong Kong lies within the tropics, and the seasonal interplay of the northeast and southeast monsoons creates a climate of cold, dry winters and hot, wet summers. The summer rains cause the Pearl River to flood, increasing its influence at this time. More important, however, is the fact that 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, via the Luzon Straits, adjacent to Hong Kong, in winter, 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 there were, for example, extensive areas of mangrove and a hermatypic coral reef community. Temporal diversity is best seen on rocky shores where temperate algae (notably *Sargassum*) grow only in winter (Hodgkiss 1984). The biogeographic location of Hong Kong, the climate, the varied influence of sea currents, proximity to the Pearl River, the long drowned coastline, wide variations in the degree of exposure to wave action and a wide shallow continental shelf have all melded to create the potential for a wide diversity of habitats. 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).

Coastal threats

During the Japanese occupation, Hong Kong's population fell to 0.6 million, but by 1950 with the defeat of the Nationalist government in China in 1949 it had risen to 2.5 million. Successive waves of immigration from China and natural population growth created the present population of 6.1 million and provided an industrious work-

force that would lay the foundations for the modern Hong Kong. In Kowloon, Mong Kok district, with a population of 170 368 (1991), has a density of 116 531 persons km^{-2}; this is the highest human population density ever known.

Hong Kong's entrepreneurial spirit has created a wide array of light industries, from those for textiles to those for advanced electronics. The lack of developable land has, however, prevented heavy industry from being established. All major developments in Hong Kong have been upon coastal reclamations and, in the past, urban and industrial centres grew together so that, today, for example, there are some 20 000 larger and 200 000 smaller 'flatted' factories and workshops. As new cities in the New Territories have been developed, much industry has moved out of the metropolitan heart of Hong Kong, around Victoria Harbour and, of late, with increasing affluence, there is an industrial shift, yet again, into southern China and other areas of Asia where land and labour costs are cheaper. For example, the Shenzhen Special Economic Zone (SEZ) around Hong Kong is a fast growing industrial centre which has benefited from Hong Kong's high infrastructural costs. The number of workers in the local manufacturing industry has thus declined from 728 000 in 1971 to 446 000 in 1994, yet Hong Kong is still the major port along the coast of China, facilitating the efficient transfer of raw materials and trade products into and out of that country and it has grown to become perhaps the busiest in the world. The central area of Hong Kong is one of the world's great centres for commerce, finance and communications. It is also a major tourist attraction, receiving some 9 million visitors each year, so that the number of workers in the service industry has risen from 639 000 in 1971 to 2 214 000 in 1994.

As noted earlier, the mountainous nature of Hong Kong has meant that, as the city has grown, virtually all new developments have had to be upon land reclaimed from the sea. This has been done by levelling mountains (so called 'borrow' areas) and using the soil and rock for coastal fill. Reclamation has many advantages over and above the simple need for land. It can be used as a revenue earner via land auctions, thereby keeping direct taxation levels down, and new developments can proceed separate from the existing city areas, thereby avoiding disruption. In 1981, the total area of land reclaimed in this way was 9.6 ha. By 1985, the figure had risen to 600 ha and by 1994 almost 5500 ha of developed land was reclaimed. By 1997, it is estimated that some 20% of Hong Kong's coastline, amounting to 160 km, will be reclaimed. The new airport footprint alone has added approximately 10 000 ha to Hong Kong's land area.

Such a scale of development has had powerful impacts upon coastal habitats about which important generalizations can be made. Eastern coastlines, falling sharply into the sea and experiencing greater wave heights, have been immune to reclamation; although affected by pollution, these shores are largely undeveloped. As is the case with the new cities of Shatin and Tai Po along the banks of protected Tolo Harbour, coastal reclamation locally encompasses shallow intertidal flats occupied by mangroves and salt meadow that are easier to reclaim. In such areas two significant storage reservoirs, Plover Cove (1967) (250×10^9 l of capacity) and High Island (1980) (273×10^9 l), have been constructed by simply building dams between island and mainland shores, pumping out the seawater and facilitating filling with freshwater. The central areas of Hong Kong, namely Victoria Harbour, have been progressively reclaimed almost since the founding of the city and this is continuing today. Other than impacts upon usable harbour area and flushing rates related to the dispersal of urban sewage, such repeated reclamations have had little effect upon a coastal intertidal community that was artificial and depauperate anyway. Just as Hong Kong's country parks are a major leisure resource in winter (receiving some 10 million visitor units each year), so the 42 gazetted swimming beaches dotted around Hong Kong have not been reclaimed because of their high recreational profile in summer.

In the western areas of Hong Kong where, due to the proximity of the Pearl River, sediment accretion rates are high, shores are naturally prograding and reclamation was initially for agriculture, prawn and fish pond culture (Irving & Morton 1988). Today, there is urban pressure on such lands and major developments are planned and, even now, being constructed along these shores. Again, it is the shallow mangrove and mudflat communities that are most amenable to reclamation. This area of Hong Kong too, in addition to the natural sedimentation processes of the Pearl River's tributaries, is sheltered from prevailing winds and waves so that protective sea walls can be lower and fill requirements are correspondingly lower.

In 1980, 1.6 million m^3 of marine sands were dredged from within the territorial waters of Hong Kong for either fill or construction purposes. For the new Port and Airport Development Strategy (PADS), presently under construction on the hitherto isolated island of Lantau, however, it is estimated that approximately 500 million m^3 of marine sand will be required. The trend in coastal reclamation for development is, therefore, away from the unsightly, expensive and disruptive activities of land-based borrowing towards the invisible, cheaper and less disruptive option of dredging for marine fill. For the PADS project, now actively underway, 75% of the world's hydraulic dredging fleet is operating in Hong Kong's waters. In addition to former uses, such as port facilities, for cooling waters and for potable flushing water, commercial fishing, recreation (swimming and boating) and the disposal of virtually all pollutants (a million tonnes of sewage and industrial wastes each day), Hong Kong's territorial waters are now being developed for other uses. These include dredging for fill, and the dumping of construction wastes, sewage and water treatment plant sludges and contaminated muds. Such muds (approximately 50 million m^3), dredged from the seabed of Victoria Harbour, prior to reclamation are dumped in marine pits that are capped with clean sand when full. Figure 2 presents a simplified illustration of the various resources, uses and activities that are a feature of Hong Kong's territorial waters and coastline. The economic development of Hong Kong has, it is now realized, come at an enormous environmental cost and, although there is much local worry about air and noise pollution and municipal waste disposal, the problems associated with water pollution in conjunction with exploitation of the fill resources of the seabed and marine dumping have also created concern.

Hong Kong's marine environmental problems are manifold and the demands upon inshore waters are growing for every use and this has created a local awareness that there is the need for coastal zone planning and management. A component of such planning is the Marine Parks Bill, passed into law by Hong Kong's Legislative Council on the 31 May 1995, coming into effect as an Ordinance on 1 June 1995, and which allows for the designation of marine protected areas locally. Such proposals and the regulations that will protect them are the subject of this paper.

Coastal management

Responsibility for coastal management in Hong Kong

The responsibility for Hong Kong's environment, at the policy level, is with the Secretary for Planning, Environment and Lands.

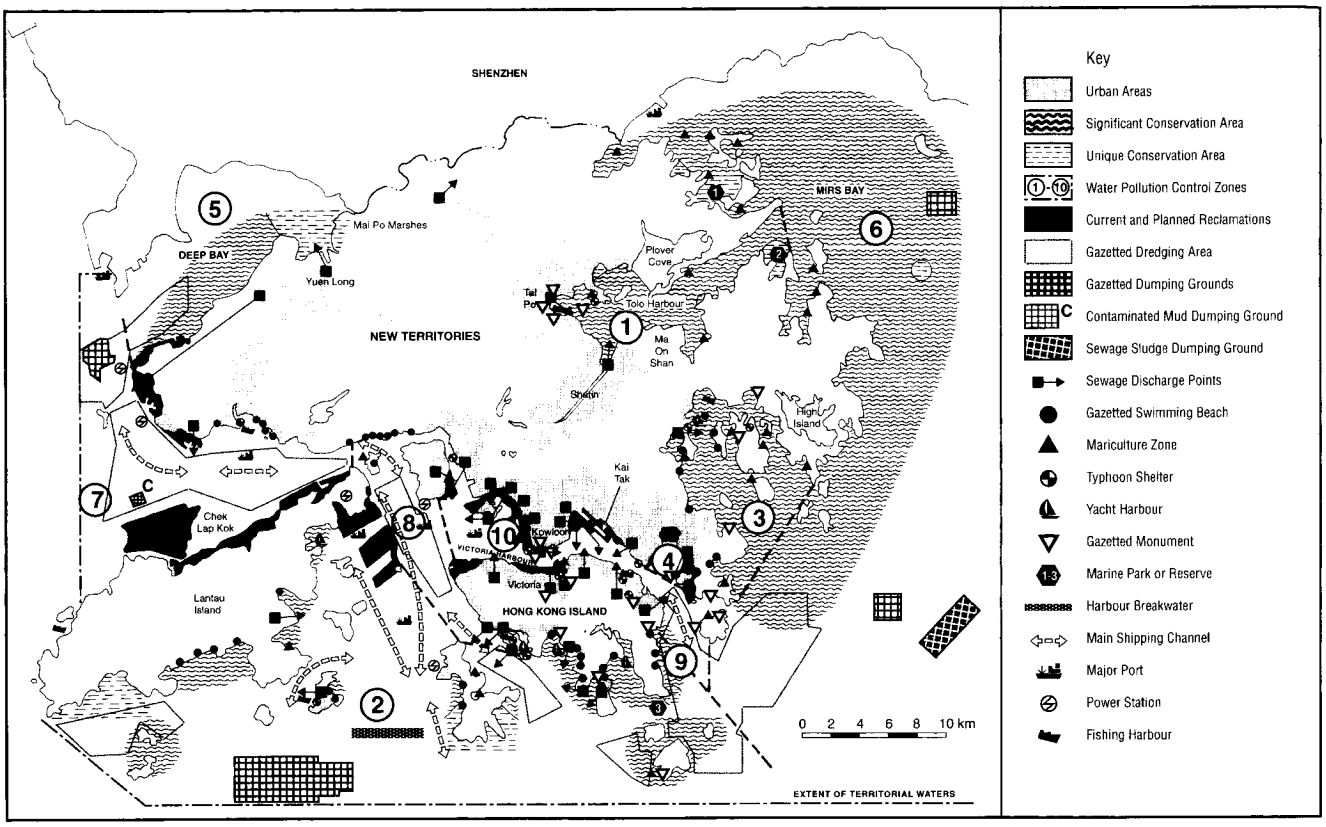

Figure 2 A map of Hong Kong and its territorial waters, showing various resources, uses and activities undertaken along the shoreline and within coastal waters. From a variety of sources.

Administrative departments include those of Planning, Lands, Environmental Protection and Agriculture and Fisheries. 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 through the Legal Department. The Marine Parks Ordinance and its Regulations allow for the establishment of marine parks and reserves and their management. Initial sites for actual designation have already been identified and will be discussed.

The question as to why, in the presence of so much legislation and potential for enforcement, Hong Kong's marine environment in particular is still in decline, however, first needs to be addressed. The answer to this question lies not so much in legislation as in politics and economics. Hong Kong's stability and prosperity after 1 July 1997 when sovereignty returns to China, must rely on its economic value to that country. To keep ahead of China, Hong Kong is now building a new port to the west of Victoria Harbour and a new international airport at Chek Lap Kok on the northern shore of Lantau Island. The cost of the Airport Core Programme has been put at US$20 thousand million in 1995, including the new rail, road and other infrastructural costs that will be needed to link the new airport to the cities of Kowloon and Victoria. It is a project that will meet the need for air transport (and port) facilities for Hong Kong to service southern China well into the next millennium. Thus, although the Special Economic Zones in China have their own international and regional airports planned (Shenzhen's and Macau's became operational in 1995), the local perception is that Hong Kong must remain central to the economic success of the region and that this project, unrivalled elsewhere, will achieve that. Essentially, therefore, in terms of coastal zone management, present problems and their control are second in the queue to economic and political forces. The Hong Kong Government has, through its Planning, Environment and Lands Branch (1993), published a second review of the 1989 White Paper on '*The Hong Kong Environment*.' The Planning Department (1993) has published a '*Territorial Development Strategy Review: Development Options*'. Together, these documents point the way to a planned future for Hong Kong's environment that includes the coastline and coastal waters (Fig. 3). Thus, in terms of marine conservation, unique and significant areas of coastline and adjacent waters have been identified. All that is needed is the political will to designate them and to categorize the remainder, thereby achieving a detailed coastal zone planning map for Hong Kong.

The Hong Kong Government has also developed a territory-wide Sewage Disposal Strategy (Environmental Protection Department 1994) that is being developed in phases. Ultimately, this could involve the discharge of sewage from the major city areas of Kowloon and Victoria into deeper, offshore, waters via a long tunnel. Debate is still, however, going on with regard to the level of treatment necessary before discharge. Some relaying of existing sewers has and is being proceeded with. With work completed for the PADS project in 1997–1998, with a modern sewage system in operation by 2003, and with a planning policy in hand for the future management of Hong Kong's shoreline and coastal waters, it is possible that the present situation can be improved upon in the next millennium. Morton (1979) published a book entitled '*The Future of the Hong Kong Seashore*'. That text clearly had no impact upon Hong Kong Government policy and, in the intervening 20 years since concerns were first raised with regard to Hong Kong's coastal environ-

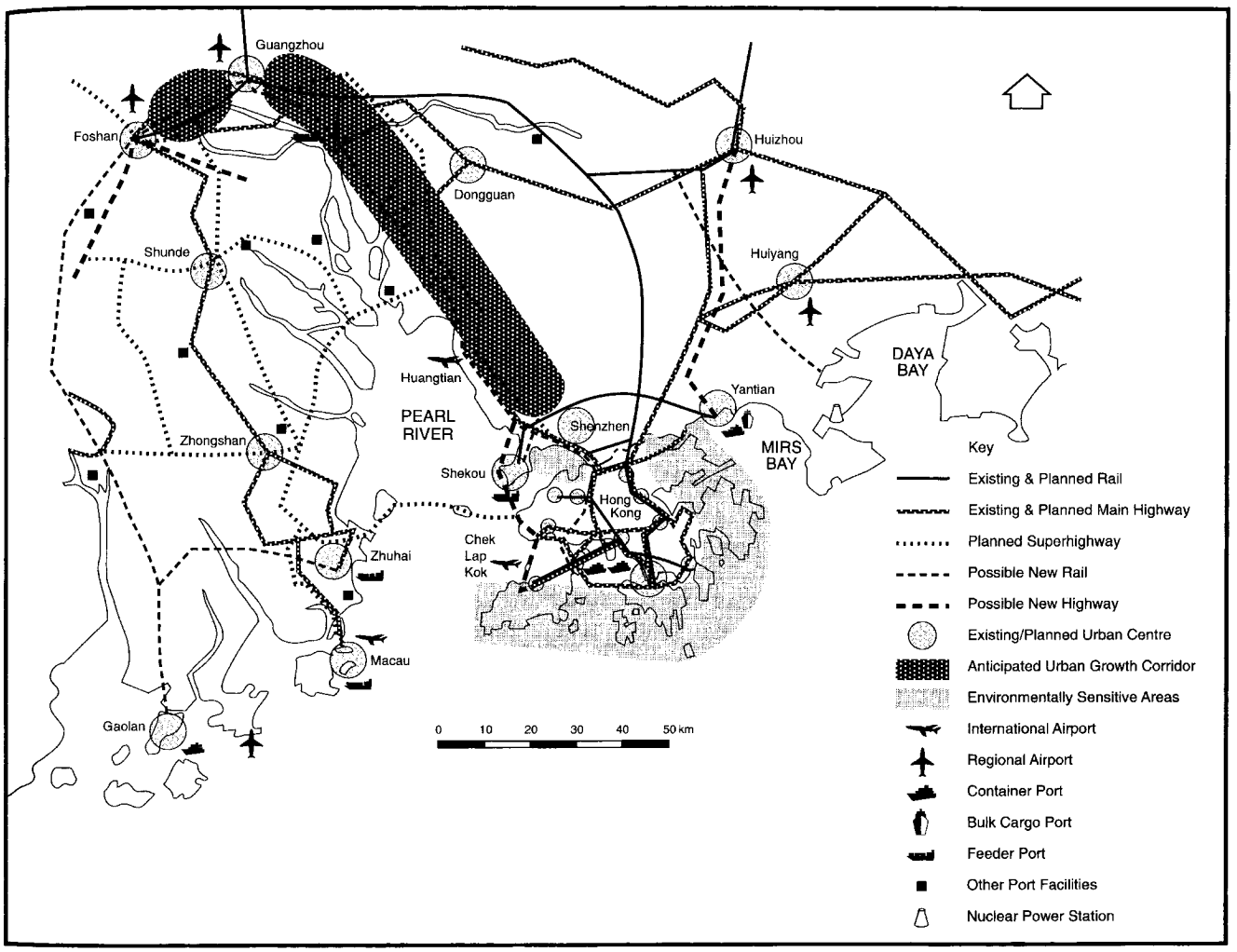

Figure 3 The overall development strategy for Hong Kong within the context of the surrounding region of southern China. Redrawn after Planning Department (1993).

ment (Morton 1976), the crisis has deepened and become more widespread throughout the territory's waters. Realistically, therefore, optimism for the next millennium is difficult to justify.

Marine conservation

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 (SSSIs), that is Tai Tam Bay and Cape d'Aguilar on Hong Kong Island were, for example, not gazetted until 24 October 1975. Since then, 32 coastal SSSIs have been identified.

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 parks and reserves 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 which was finally passed into law by Hong Kong's Legislative Council on 31 May 1995 and came into effect on the next day. It provides the framework for the designation, management and development of marine parks and reserves in Hong Kong.

The Marine Parks and Reserves 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; and
- 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 will be the responsibility of the Country and Marine Parks Authority (Director of the Agriculture and Fisheries Department of the Hong Kong Government), with advice from the Country and Marine Parks Board and, in turn, its Marine Parks and Reserves Committee.

A multiple-use approach will be adopted within the proposed marine parks and reserves to allow those existing activities which have little detrimental effect on the marine environment to continue. The levels of control within marine parks and reserves will vary according to activity, but will be more stringent in the latter.

For example, existing fishing activities which are considered sustainable will be allowed in marine parks and controlled through a licensing system. All fishing activities will, however, be prohibited in a marine reserve.

The establishment of marine parks and reserves, together with other management and enhancement measures, such as the possible deployment of artificial reefs, but whether within or outside the parks is as yet undecided, will help protect fish nursery grounds and enhance inshore fish stocks. This will promote sustainable exploitation and, it is argued, benefit fishermen in the long term. In order to achieve this objective, incompatible fishing activities, such as bottom trawling and spear fishing, will be banned in both marine parks and marine reserves. Other fishermen, based at homeports near marine parks and using boats less than 15 m in length will be able to apply for a fishing permit to be renewed on an annual basis. This will allow them to continue their fishing activities.

The Marine Parks and Reserves Working Group, now the Marine Parks and Reserves Committee, identified Yan Chau Tong/Lai Chi Wo, Hoi Ha Wan and Cape d'Aguilar as potential sites for marine parks and marine reserves and recommended their designation (Fig. 4).

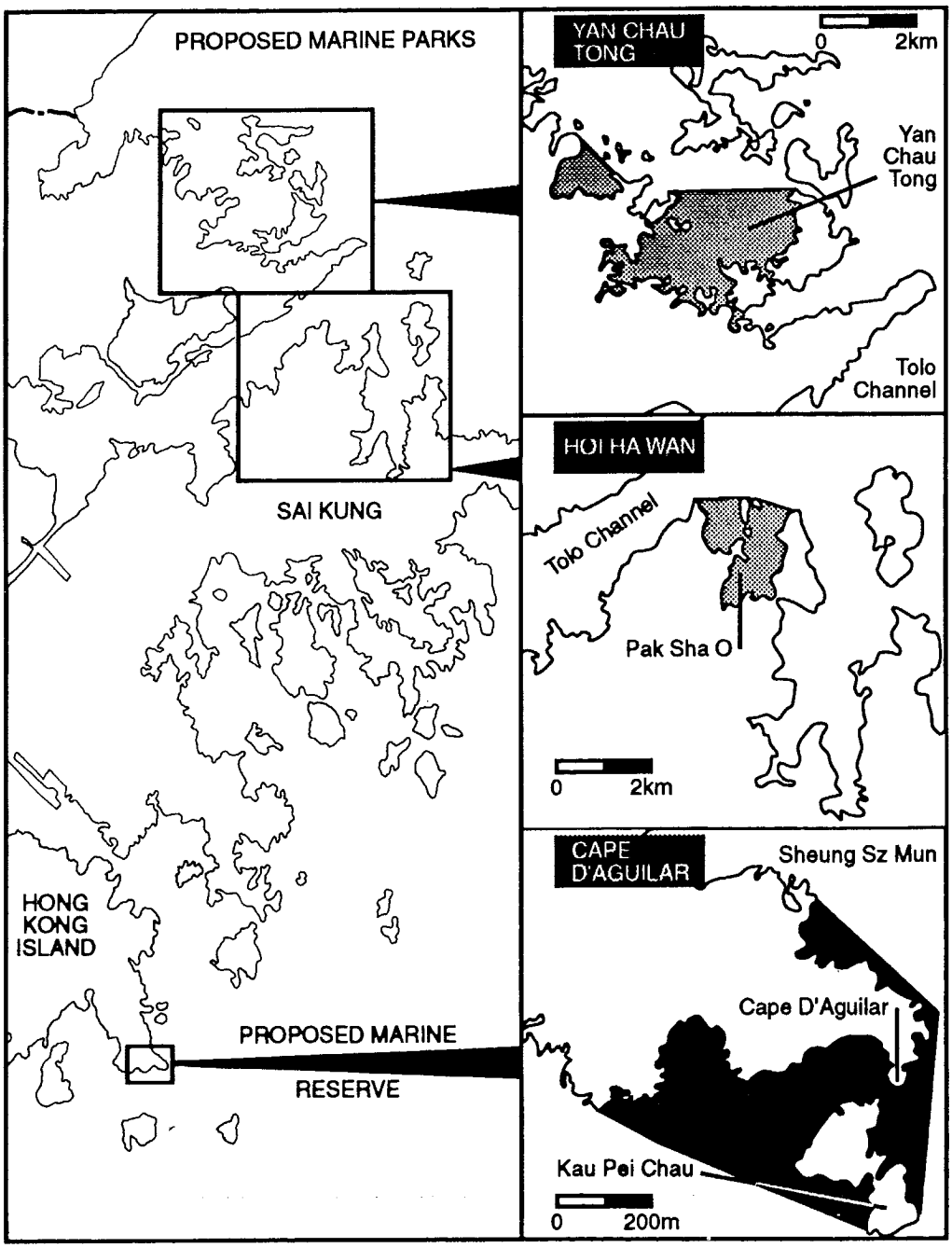

Figure 4 The proposed marine parks at Yan Chau Tong/Lai Chi Wo, Hoi Ha Wan, and proposed marine reserve at Cape d'Aguilar. After Morton and Harper (1995).

Hoi Ha Wan

The proposed 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 ha (Figs. 1, 4) and is confluent with the Sai Kung Country Park. The bay has a rich coral community on its flanks (Cope & Morton 1988; Zou *et al.* 1992) 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. 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 (1992). World Wide Fund for Nature Hong Kong has plans to build an Education and Conservation Centre at Hoi Ha.

Yan Chau Tong/Lai Chi Wo

The proposed marine park of Yan Chau Tong/Lai Chi Wo in the northeastern New Territories of Hong Kong comprises the highly indented bay of Yan Chau Tong and a smaller area east of the village of Lai Chi Wo: it has a sea area of about 680 ha (Figs. 1, 4). 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 (B. Morton & J. Morton 1983) and the only situation where there are thriving seagrass (*Zostera nana* and *Halophila ovata*) beds (Hodgkiss & Morton 1978). The remoteness of the site, confluence with the Plover Cove Country Park and the lack of any developments, its highly indented coastline and variety of intertidal habitats, make it an extremely valuable conservation area.

Cape d'Aguilar

The proposed marine reserve at Cape d'Aguilar on the remotest tip of Hong Kong Island has a sea area of about 18 ha (Figs. 1, 4). The fact that it is a peninsula and includes the island of Kau Pei Chau, however, gives it an extensive and varied shoreline. Over a short period from 1985 to 1992, when international scientists have been able to visit Cape d'Aguilar, twelve new species of animals have been described from its shores. Some of these, such as the small nemertean *Pantinonemertes daguilarensis* described from rocky shore crevices and minute arthropod mites from the interstitial habitats of mobile sands in Lobster Bay are rarely seen by most people. Others, 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. Yet, until such research was done, we had no idea of their significance for Hong Kong. Morton and Harper (1995) describe the geology, geomorphology and ecology of the Cape d'Aguilar Marine Reserve.

For a number of pragmatic reasons, therefore, such as its remoteness, scenic beauty and vulnerability but, more importantly, its restricted accessibility, the feasibility of affording protection and the desirability of exploiting its potential for research and education, Cape d'Aguilar is considered an ideal experimental marine reserve. Such factors are matched by its geological richness and the wealth and diversity of its contained flora and fauna which include an intertidal coral pool. The presence of the Swire Institute of Marine Science of the University of Hong Kong within the reserve will foster its development.

Other conservation areas

The Mai Po Marshes

The Mai Po Marshes Nature Reserve is the most significant local wetland and covers an area of some 380 ha of reclaimed land on the northwestern shoreline of Hong Kong, at Deep Bay (Fig. 5). It comprises 209 ha of fish ponds and tidally flushed prawn ponds (*gei wai*) and a 172 ha coastal strip of mangroves (Irving & Morton 1988). Some of the ponds have been converted into other wetland habitats, thereby increasing the diversity of the reserve. Lee (1993) inventories 81 species of invertebrates from Mai Po of which 13 (16%) are undescribed.

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. The 'Reserve' is not actually a designated reserve, merely a component of the Deep Bay Site of Special Scientific Interest (SSSI). The significance of a local SSSI being afforded Reserve status was, however, substantiated on 4 September 1995, when the area 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 example, some 65 000 waterbirds may visit the reserve and although in early summer there are fewer visitors (20 000–30 000), on any day there may be 10 000 birds present (Young & Melville 1993). Mai Po is clearly a very important stopover place for birds migrating into and out of China where such habitats are declining steadily.

Opposite Mai Po is the Fu Tian Nature Reserve in China which is of a similar size but much longer and narrower than the former. Six species of mangrove 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 species from Hainan failed.

At both Mai Po and Fu Tian, mangroves are relatively short, reaching a maximum height of only 5 m. Disturbance to the inland section of the mangrove has halted succession, so that only a pioneer community of *Kandelia*, *Aegiceras* and *Avicennia* is typically present. Due to the growth of the Shenzhen Economic Zone around Fu Tian and urban developments around Mai Po, there are strong pressures on the integrity of both reserves (Young & Melville 1993).

A marine park at Lung Kwu Chau and Sha Chau

The northwestern waters of Hong Kong, in particular the area around Lung Kwu Chau and Sha Chau, are important feeding grounds for a small population (approximately 80 animals now) of the Indo-Pacific Humpback dolphin or Chinese white dolphin *(Sousa chinensis)*. Their survival is being affected by the cumulative effects of pollution, habitat loss, reduction in food availability and stress caused by development projects. Marine traffic is also increasing in this area of Hong Kong, which is proposed for major development by the Planning Department of the Hong Kong Government. Such northwestern waters, congruent with the Pearl River, the Special Economic Zone of Shenzhen and the Province of Guangdong, are a natural waterway facilitating trade between Hong Kong and China.

The Provisional Airport Authority (PAA) proposed the construction of an Aviation Fuel Receiving and related Facility (AFRF) at Sha Chau for the new airport at Chek Lap Kok. To fully evaluate such impacts, the PAA invited a dolphin expert to identify additional practical mitigation measures to minimize impacts upon the dolphins (Würsig 1995). The study 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.

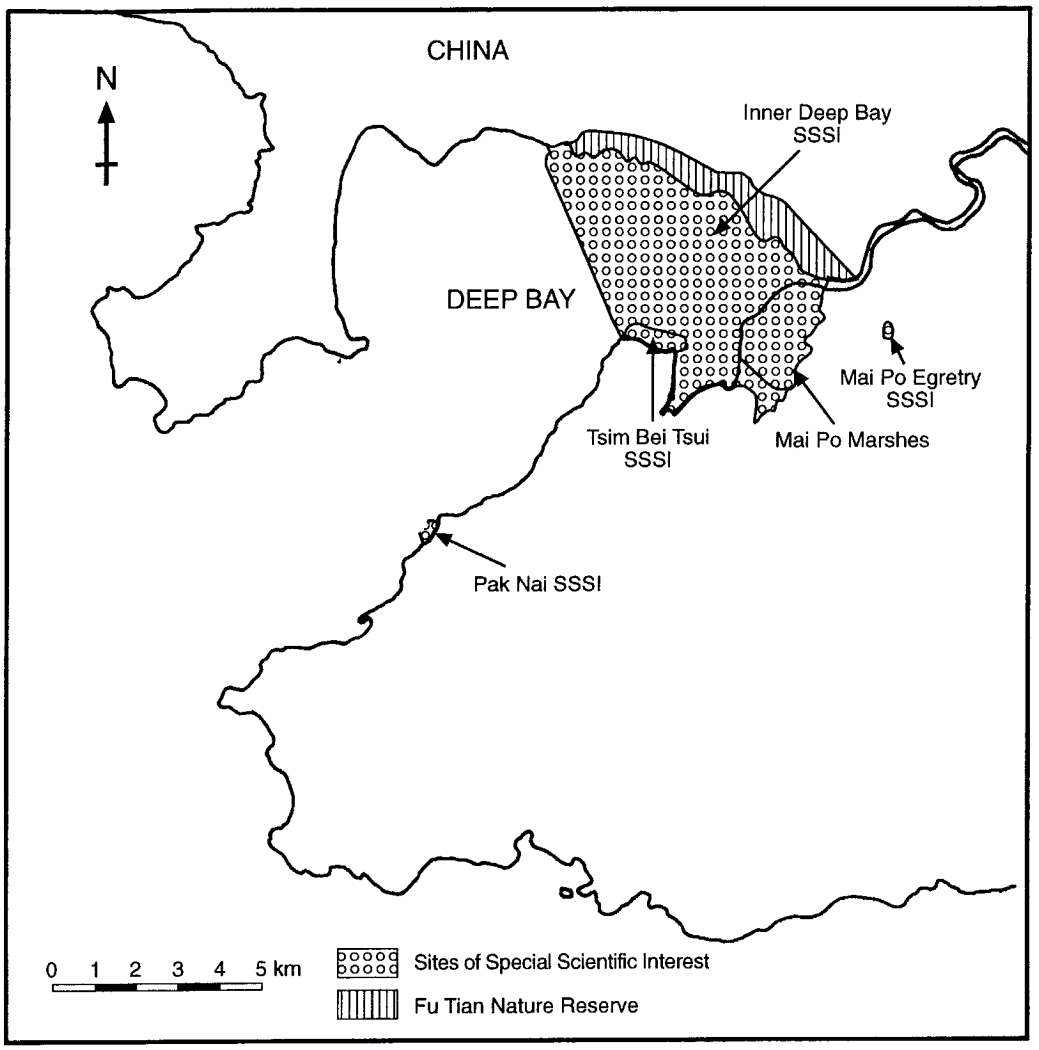

Figure 5 The Mai Po Marshes Nature Reserve, the Fu Tian Nature Reserve and the Deep Bay Site of Special Scientific Interest (SSSI) in the northwestern waters of Hong Kong. After Young and Melville (1993).

Recommended also was the creation of a marine park which would serve as a dolphin sanctuary around the Sha Chau and Lung Kwu Chau area and the possible implementation of an artificial reef programme within it (Würsig 1995).

The loss of coastal habitats due to the construction of the new airport at Chek Lap Kok, increasing marine traffic, toxic wastes in the contaminated mud pits nearby, dredging of marine fill and the discharge of inadequately treated sewage from three major outfalls, have collectively acted to degrade the waters off North Lantau (Fig. 6). The degradation of the environment has affected other marine organisms in the area which in turn has reduced the amount of food available to the dolphins and exposed them to physical harm, for example, boat propellers and disease (L. Porter, personal communication 1995). In 1994, nine dolphin corpses were reported from the shores around the proposed park and ten had been identified up to the end of 1995. In 1994, there were seven births and, in 1995, four young were born, one of which has died (L. Porter, personal communication 1995). Parsons (in press) estimates that the population will die out within five years in Hong Kong unless serious consideration is given to protecting it, and this has stimulated the recent proposal to designate the islands of Lung Kwu Chau and Sha Chau and 1200 ha of coastal water as a marine park (Fig. 6). A feasibility study of such a proposal has, however, concluded that it is not viable, and that with the current rate of local extirpation (20% per annum) such a designation is pointless (Hoffmann 1995), unless the area scheduled for protection is greatly increased and stricter regulations introduced.

Marine conservation in China

The initial approach taken by China to marine conservation was primarily concerned with the regulation of fishing activity. Fisheries law in China, as in Hong Kong, prohibits the use of dynamite, poison and electricity in fish catching and protects endangered species (Anon. no date). Overexploitation of protected areas is attempted through restrictions on fishing activities. There is a year-round ban on bottom trawling throughout Chinese waters, including those around Hong Kong. In 1979, the Guangdong Provincial Government imposed a ban on bottom trawling down to a depth of 40 m. Spawning and nursery grounds of commercially important species around the coast are further protected by the seasonal closure of sensitive areas to any form of fishing.

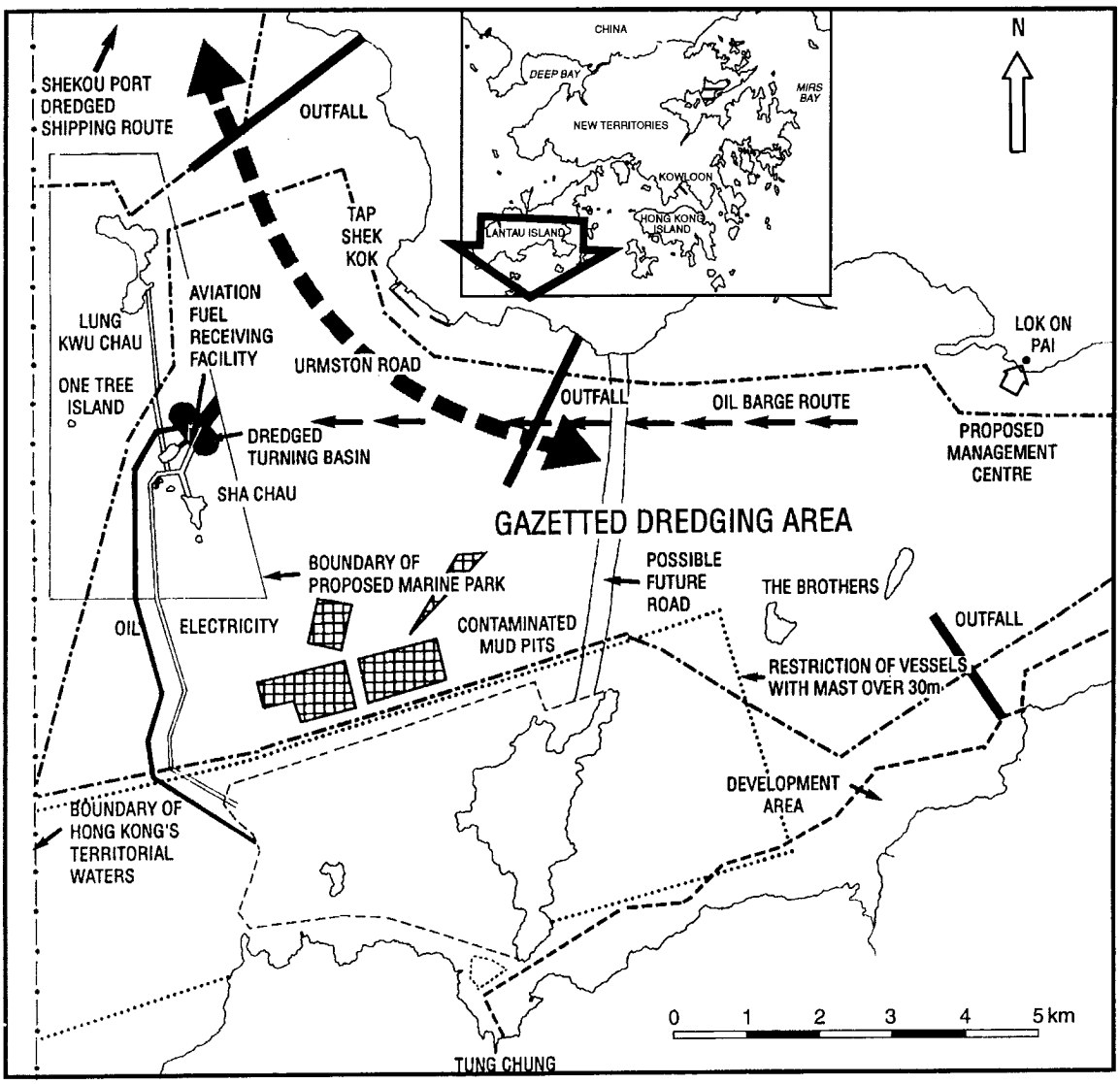

Figure 6 The proposed Marine Park at Lung Kwu Chau, Sha Chau and One Tree Island in the northwestern waters of Hong Kong for the Indo-Pacific humpback dolphin. Also shown are the developments either proposed or currently under construction in adjoining waters.

In 1988, China embraced marine conservation initiatives that go beyond fisheries regulations when the State Oceanic Administration was made responsible for designating and managing marine nature reserves at the State and Province levels. Since then, seven national marine nature reserves and provincial reserves with a total area of 1295 km^2 have been established and more are planned (Anon. no date).

The State Oceanic Administration's '*Action plan for marine diversity protection in China*' calls for the establishment of:

- three more marine conservation areas, that is, the Miaodao Archipelago, Nan-ao Island and Weizhoudao and Xieyang Islands;
- four coastal wetland marine conservation areas, that is, Liaodong Bay, West Bohai Bay, Chongmin Dongtan in the Changjiang estuary and Quanzhou Bay;
- a series of coral conservation areas, that is, Dongdao Island in the Xisha Islands group, Dongshan Island and Nansha Yongshujiao, all in the South China Sea;
- a series of mangrove conservation areas, that is, the Beichang estuary to Pearl Harbour in Guangxi Province, Zhangjiang in Fujian Province, Qingzhou Bay in Guangxi Province; and
- 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.

Discussion

The earliest marine protected area was Glacier Bay, Alaska, which was established in 1910 as a national monument. The Fort Jefferson National Monument, Florida, was set up in 1935 and covers an area of some 18 850 ha of sea and 35 ha of coastal land. The first marine park for the protection of corals was the John Pennekamp Coral Reef

Sanctuary, Florida, established in 1960. Such developments in the United States went unmatched elsewhere in the world until 1962, when the first World Conference on National Parks focused on the need for designation of marine sites in recognition of the rapidly growing threats to their natural beauty, cultural heritage and their unique floras and faunas. From this basis, the number of marine protected areas grew in the 1970s and 1980s and by 1985 approximately 1000 sites in 87 countries had been either designated or proposed. The IVth World Congress on National Parks and Protected Areas declared that, by the year 2000, 20% of the coastal zone should be designated as coastal or marine protected areas, under agreed management plans (IUCN 1992). Such sites range in size from the Great Barrier Reef of Australia to small shore areas no more than a few hectares in extent, for example Lundy Island off the coast of Somerset, Great Britain.

The reasons behind the designation of marine protected areas are many and varied. Some are strongly focused, such as on habitat fragility, diversity, rarity, naturalness or its representativeness with regard to a particular feature. Others are more pragmatic, relating to the area's situation, history, cultural value, vulnerability, intrinsic appeal, scientific value or educational potential. An area may also have economic value, for example a commercial fish nursery area. Whatever the reason or reasons for its designation, each site is unique, and established by virtue of local, national and even international acclaim. In an increasingly pollution-threatened world, governments are being asked to respond to calls for environmental conservation in a positive way. Jones (1994) reviews and analyses such objectives in the context of marine reserve designations.

The modern approach to conservation, which can be broadly categorized as 'sustainable development', is that the establishment and management of marine protected areas is being incorporated into planning schemes whereby the zoning of an area of foreshore and sea is linked to potential use, thereby allowing control of any activities within it. By defining and apportioning activities and allowing only compatible ones to coexist, not only can conflicts between potential users be avoided, but multiple uses are possible to achieve maximum benefit for society as a whole. It is thus possible to establish a marine reserve for strictly educational and research purposes, but it is also possible for the natural hatchery of an important fish species to be included within a protected area, thereby lowering overall management costs. Similarly, the conservation of a scenically aesthetic seascape is not incompatible with tourism if the latter is managed to protect the reason for the area's original designation. Such a multiple use scheme ensures that activities and people are not excluded from a communal heritage, except those that would cause either its deterioration or destruction. It is this approach that is being adopted by the Hong Kong Government, albeit tentatively.

It was not until 1993 that there was support for legislation to conserve the marine environment in Hong Kong and, thus, protect the elements of its coastal heritage. Hong Kong is, however, broadly speaking, in step with China and its marine conservation policy, and Hong Kong's Marine Parks Bill has now been passed into law and will allow for the eventual designation of local sites as parks and reserves, as described above. When these marine parks and reserves are designated, they will hopefully help to protect the rich and diverse communities of Hong Kong's shore and coastal seascapes for the enjoyment of present and future generations. The designation of the Mai Po Marshes as a RAMSAR site in 1995 reflects the internationally recognized importance of the area; the marine parks and reserve at Cape d'Aguilar have also been proposed through scientific consensus. The proposal to establish a marine park sanctuary at Lung Kwu Chau and Sha Chau for *Sousa chinensis* is, however, largely a political decision and will probably not work as the dolphin population is already considered to be non-viable and the threats to its habitat can only increase. Inspection of the maps of Hong Kong presented here, however, illustrates one other point: all the sites mentioned are located at the periphery of the territory.

Pollution, non-regulated fishing, development and reclamation have done their work in Hong Kong and what is now surviving, is doing so at the edge. That Mai Po is threatened by surrounding development, that the dolphin sanctuary is considered non-viable, that all the colonies of the coral *Porites lobata* have recently died within the proposed Cape d'Aguilar Marine Reserve (Clark 1995) and that the corals of Hoi Ha are still in decline (Zou *et al.* 1992), suggest that such conservation measures may be already too late. Surrounded by the Shenzhen Special Economic Zone within the southern Chinese Province of Guangdong, which is itself undergoing massive and rapid development, Hong Kong's conservation areas are under pressure from within and from without. It is therefore crucial that Hong Kong's conservation policy be linked to that of China, so that post 1997, when sovereignty reverts to that country, there is the potential for something to survive the transition.

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