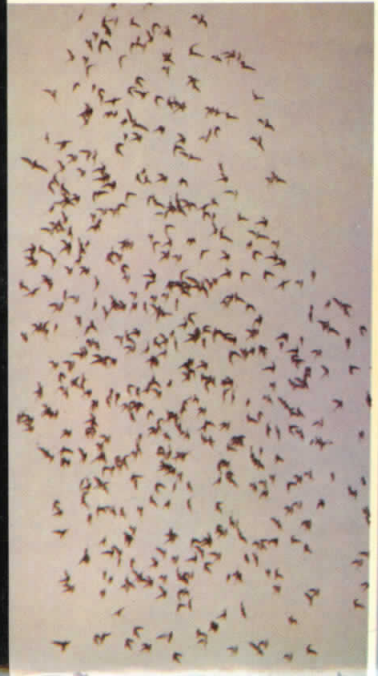




MAI PO MARSHES



MAI PO MARSHES

D.S. Melville
and
Brian Morton

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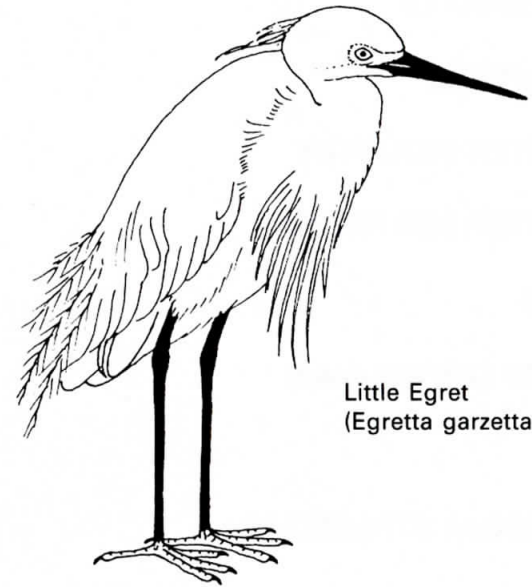
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FOREWORD

"On three occasions I have visited Mai Po Marshes and have spent fascinating and happy days there each time watching birds and butterflies. With its tidal mud flats, mangrove swamps and *kei wei* fisheries, the area is the only remaining significant piece of wetland habitat in the Hong Kong territory. It has an abundance of wildlife of many kinds; birds, butterflies, fiddler crabs, and other creatures of the mangrove being particularly interesting. Over 200 species of birds may be seen here, ranging from Pelicans to Dusky Warblers, from Imperial Eagles to Temminck's Stints, from Ospreys to Richard's Pipits. I saw my first wild Falcated Teal there. Some species like the Saunders' Gull, Swinhoe's Egret and the Spoon-billed Sandpiper are extremely rare.

Mai Po would provide a marvellous place for a Wildlife Education Centre and a most valuable opportunity for Hong Kong. It also has considerable potential as a research and monitoring station for the migratory birds using the China Coast as a flyway: a route at present little known to ornithologists and evidently with very few protected areas along the way."

Sir Peter Scott
September, 1982



Little Egret
(*Egretta garzetta*)

INTRODUCTION

The massive development that has overtaken Hong Kong, especially the New Territories, has not been without its cost to wildlife. Quite literally mountains have been moved into the sea and the reclamation used for the development of new towns. As a result large areas of foreshore have been lost and typically this has comprised the flat alluvial plains of river and stream mouths. This process has resulted in the destruction of wetland habitats especially the mangroves – those trees in the sea so characteristic of tropical estuaries and possessing a unique flora and fauna. Wild places are vanishing and most that remain are in hill country, the Mai Po Marshes bordering Deep Bay being the only extensive area of wetland remaining in Hong Kong.

At Mai Po coastal plants flourish and here are recorded Hong Kong's tallest mangrove trees. The large intertidal mud flats of Deep Bay support a rich and varied fauna of invertebrate animals providing a larder for fish and the large flocks of migratory birds which visit Hong Kong from breeding grounds as far away as northern Siberia. Inland of the mangrove, shallow shrimp ponds add variety of habitat with brackish water plants and animals.

The wealth of plant and animal life at Mai Po, comprising a mixture of tropical and temperate forms, provides a very rich resource for the people of Hong Kong. The student of natural history can approach and study these wetland habitats with ease, while the casual visitor can enjoy the wealth of wildlife which still remains.



B.S. Morton



B.S. Morton

PHYSICAL SETTING AND LAND USE

Deep Bay lies in the northwestern sector of the New Territories, bordered along its northern and western shores by the Peoples' Republic of China. It is the largest estuarine area in Hong Kong.

The structural depression, of which Deep Bay is part, extends in an arc from Castle Peak Bay to the Shum Chun River and eastwards to Lo Wu, and is underlain by rocks of the Lok Ma Chau formation. Both geomorphological and historical evidence suggest that most of the deposition in this area has occurred in historical times. Within the last 1,000 years the present Castle Peak Peninsula was an island and ships were able to sail from Castle Peak Bay to the seaport of Yuen Long, although the channel was probably shallow and lined with mangroves.

In contrast to its name, Deep Bay, which has an area of 112 sq km, has an average depth of only 3 m and is nowhere deeper than 6 m. The bottom of the Bay is covered with thick mud and silt. With a maximum tidal range of about 2.8 m there are large areas of exposed mudflats at low tide.

The Shum Chun River flows into Deep Bay from the northeast, and the Bay in turn opens into the Pearl River estuary. Some sediment is brought into the Bay by the Shum Chun River and Yuen Long Creek but it is probable that suspended solids brought into the bay on flood tides from the Pearl River are also an important source of sediments. The inner shores of the bay are fringed with

dwarf mangrove plants and these aid accretion by 'trapping' silt particles around their roots. Furthermore there is evidence that the area has been subject to geological uplifting in very recent times – possibly by as much as five metres in the last 1,000 years.

In addition to natural deposition and uplifting there has been considerable reclamation around the Bay. Land tax records suggest that reclamation first took place around Yuen Long some 1,000 years ago, probably being undertaken by soldiers from the garrison there. The Man clan settled at San Tin in 1279 and have made extensive reclamations in that area. Around 1920 a private company built a sea wall and a system of sluices across the mouth of the Ping Shan Creek; this produced over 325 ha of land for paddy farming.

Another form of reclamation has been the construction of shallow tidal shrimp ponds, known locally as *kei wais*. These are made by impounding with mud bunds an area of mangrove with a sluice to control the movement of sea water in and out of the pond. The *kei wais* which form the Mai Po marshes were constructed between 1941 and 1949 and aerial photographs taken in 1949 clearly show the pattern of natural drainage channels through the original mangrove. After a period of time the mangroves spread over the mud flats to the seaward of the ponds and a new *kei wai* can be made. Deposition of silt in the former *kei wais* builds up a soil suitable for brackish water paddy and the reclamation cycle proceeds.

In 1960 there were some 810 ha of *kei wais* in the

Deep Bay area but many have now been converted to deep fish ponds and today there are only about 150 ha, all in the Mai Po area.

There is little doubt that the area around Deep Bay was used for paddy farming from the very early days of human settlement. At the time of the first comprehensive survey of agriculture in Hong Kong in 1954 there were 9,450 ha of paddy (70.3% of the total area under cultivation), much of it around Deep Bay. By 1969 there were 5,870 ha (43.3%), and in 1981 there were only 10 ha, none of it near Deep Bay.

Changing economic conditions resulted in paddy lands being converted to market garden vegetable areas and deep, freshwater fish ponds for the culture of species such as mullet and carp. By 1978 there were 200 ha of fish ponds, mostly in the Yuen Long district. Although new fish ponds are still being created, increasing urbanization has resulted in a gradual reduction in the area of ponds and in 1981 there were 184 ha.

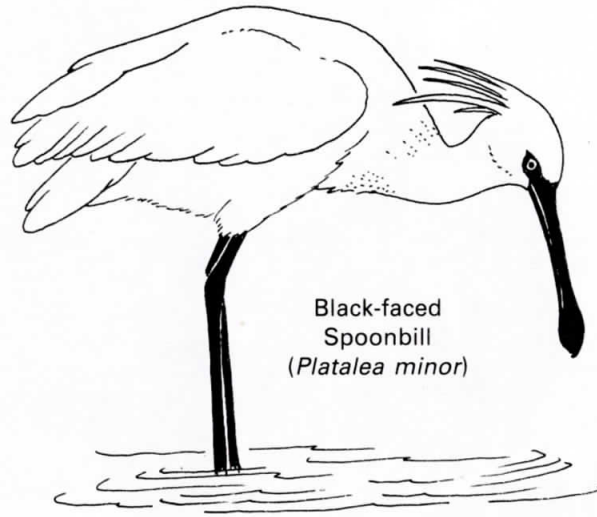
The first major development to result in the reclamation of fish ponds near Deep Bay was the construction, begun in 1976, of a 'Garden' housing estate for 30,000 people at Tai Shang Wai. The Yuen Long Industrial Estate, reclamation for which will be completed in 1983, will cover 98 ha of former agricultural land, and the town of Yuen Long has expanded considerably in recent years. The populations of Yuen Long and Tuen Mun have increased from about 175,000 in 1971 to 308,700 in 1981, of which about 51,500 were in Yuen Long New Town. The establishment of a Special Economic Zone



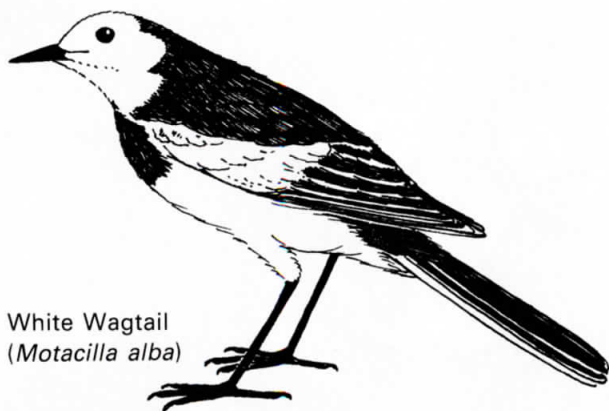
The first aerial photograph of Mai Po taken in 1949 and showing the natural drainage channels and the drainage channels from the *kei wais*.

just across the border at Shenzhen is also resulting in former agricultural land being reclaimed for building and there has been a considerable increase in the population.

The development of the Deep Bay hinterland for non-agricultural purposes is placing mounting pressure on the Bay through direct reclamation and concomitant disturbance as well as through increased levels of domestic and industrial effluent being discharged into it.



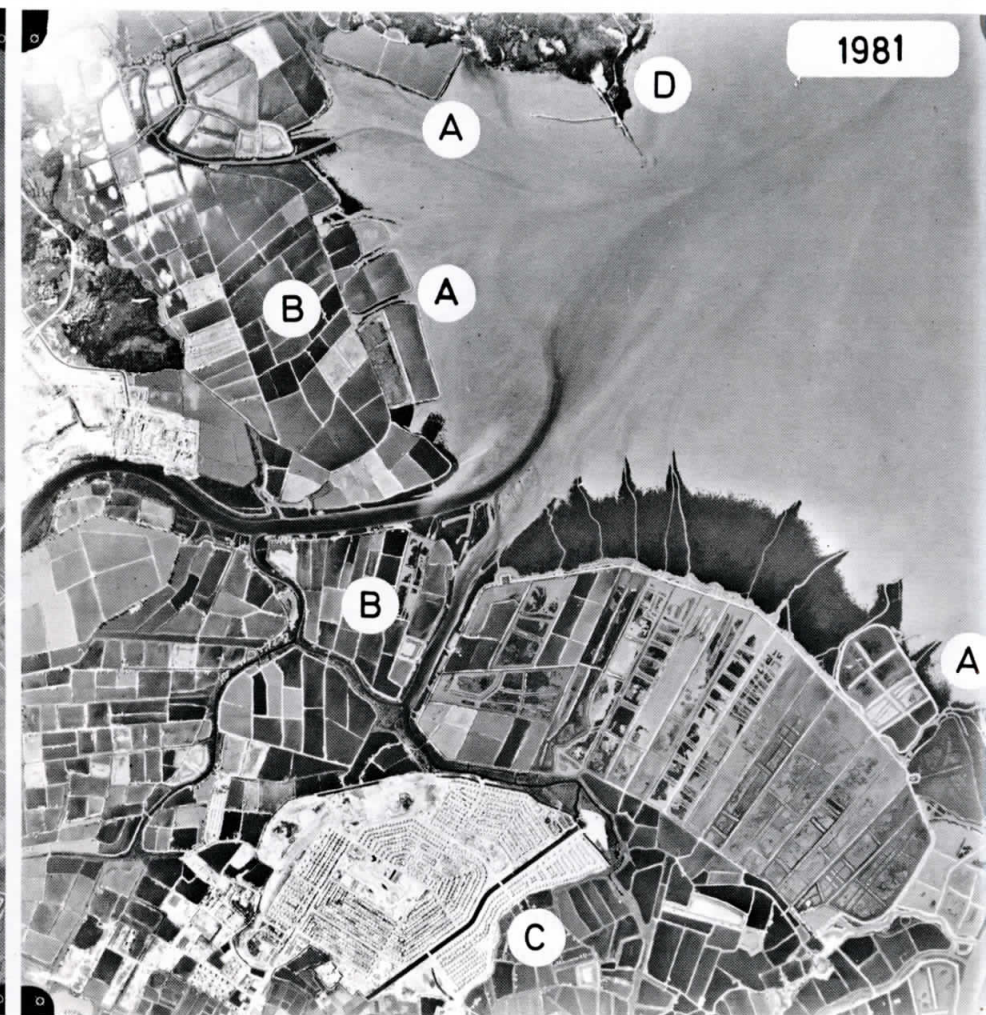
An aerial photograph of Mai Po in 1969 showing how little development of the area there was up until that time.



White Wagtail
(*Motacilla alba*)

Aerial photographs of Mai Po taken in 1973, 1975 and 1981 showing the progressive development of the area, first with (A) the cutting of deep fish ponds, (B) conversion of marsh for vegetable farming and (C) the construction of the 'Garden' housing estate at Tai Shang Wai to the south west of the marsh. The small mangrove at Tsim Bei Tsui (D) still survives and is a good example of a complete, almost natural stand.





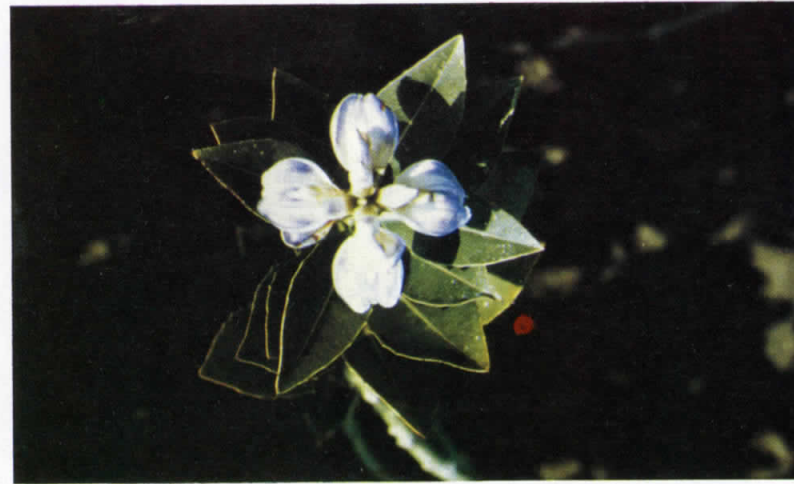
PLANTS

Characteristically tropical mangroves merge gradually and imperceptibly with rain forest. The 'pioneer' plants of the seaward fringe by accretion and 'dropper' fall extend their influence yet further into an estuary. With seaward progression more landward conditions become unsuitable for pioneer habitation, being now above the level of all but the highest tides and the older trees gradually die. They are replaced by secondary mangroves which, less specialized than the pioneers, effect the transition to forest plants. In Hong Kong the forest has long been cut and at Mai Po the area normally occupied by secondary mangroves has also been impounded for *kei wais*, so that the mangrove here comprises a pioneer community only. The dominant plant towards the rear of the mangrove, in front of the most seaward bund, is *Kandelia candel* (Rhizophoraceae) with prop roots and thick fleshy leaves. The tree here grows tall and slender to a height of some 5 m. The long, bright green, reproductive 'droppers' hang down from the upper branches and the trees are formed into a tangled mass by the climbing *Derris trifoliata* with pointed leaves and producing short pods of a leathery texture when mature. A thick mass of *Kandelia* extends for some 200 m onto the shore, progress through it also being made more difficult by short plants of the prickly mangrove *Acanthus ilicifolius* (Acanthaceae). Here the mud is soft and squelchy, the explorer rarely able to proceed for but a few yards without becoming thoroughly stuck.



Aegiceras corniculatum

B.S. Morton



Acanthus ilicifolius

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Further seaward the *Kandelia* is progressively replaced by the shorter trees of a mixed stand of *Avicennia marina* (Avicenniaceae) and *Aegiceras corniculatum* (Myrsinaceae). The grey mangrove *Avicennia* has leaves which are thin, pointed apically and more green above and grey below. The undersurface is typically covered by salt crystals – these being secreted from special glands. The roots of *Avicennia* are long and cable-like. At regular

intervals along each root, a pneumatophore projects vertically upwards, thus permitting gaseous exchange with the air or water above and thus providing the roots, living in anaerobic mud, with their own immediate source of oxygen. *Avicennia* produces small, bean-shaped, seeds.

Aegiceras, the brown mangrove, so-called because of its red-brown stem and leaf internodes has leaves re-

Kandelia droppers

Aegiceras droppers

Canavalia flowers and seed pods

Derris trifoliata



B.S. Morton



Barnacles encrust the stems of the more seaward mangroves.

B.S. Morton

sembling those of *Kandelia*, thick and fleshy, with a rounded apex. The flowers produce small sickle-shaped droppers easily distinguishable from those of *Kandelia*. The roots are cable-like, periodically formed into 'knees' that project above the mud surface and serving the same function as the pneumatophores of *Avicennia*.

The seaward fringe of the Mai Po mangroves is dominated by the prickly mangrove *Acanthus*. Elsewhere this species is high-zoned and its unusual occurrence at Mai Po is probably an indication of the degree of disturbance this habitat has suffered over many years. Certainly much of the observed seaward growth of the mangroves at Mai Po over the last 30 years has been by

Acanthus. The white and lilac flowers of this plant stand erect from the central axis producing a green seed. The leaves of *Acanthus* are according to location soft with few spines or as hard as holly, scratching unprotected legs and arms.

With a decline in use and maintenance, the *kei wais* of Mai Po have become, of late, much more densely colonized by plants. In many places the dominant plant is a species of *Phragmites*, a reed with long, slender, leaves arising from the base and a plume-like inflorescence. This grows with the root base constantly in wet mud. The banks of the bunds and the central shallower



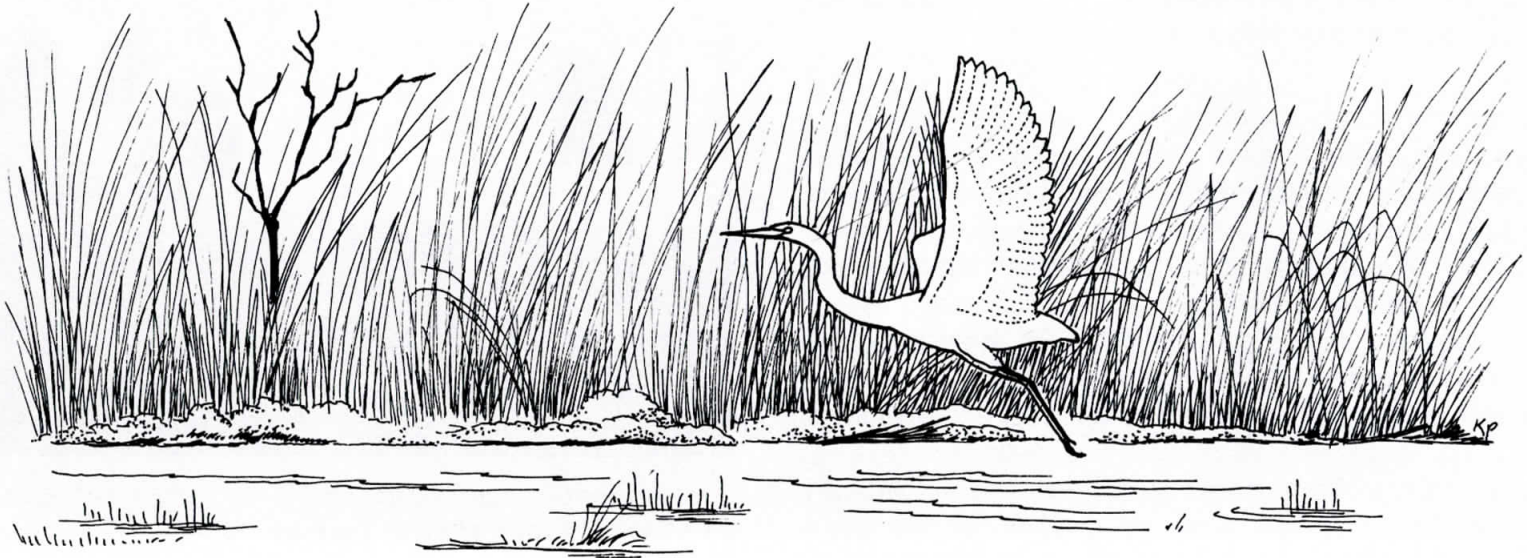
Phragmites plumes; the seeds are an important food of birds such as Buntings.

B.S. Morton

areas of the ponds have progressively acted as foci for plant growth. Here, all the aforementioned mangroves grow as scattered individuals, only in the pond centre forming dense cover with *Phragmites*.

Located well above the level of high water, only the bunds can permit extensive diversification of the plant community. Walking along the bunds one's view to left and right is obstructed by the reeds and mangrove plants growing on the bunds' edge. But of course one is also hidden from the view of the birds – the object of many a naturalist's attention. In this higher-zoned position the mangroves are often entwined by another creeper –

Canavalia maritima – with round leaves and a long seed-pod, quite distinct from that of *Derris*. On the sides of the bunds too occurs the mangrove fern *Acrostichum aureum*, a large plant with simple, pinnate upright fronds and with a fertile, terminal pinna. *Clerodendron inerme*, a low shrub with long branches arcing outwards from the root base and with widely separate leaf clusters, is another typical coastal plant. Coastal grasses (*Paspalum distichum*) and sedges (*Cyperus malaccensis*) line the bunds to each side of the central beaten footpath and among these can be found an array of smaller, but not necessarily mangrove or even coastal, plants.



INVERTEBRATES

The mangrove associated fauna of the Mai Po marshes has not been the subject of extensive research but sporadic field collections have enabled the construction of a community picture at least for the larger, more conspicuous, species. A lack of coastal zone ecologists in Hong Kong means that the smaller, less obvious components of many beach habitats have not been properly investigated. Mai Po is a good example of this and it seems likely that with the saddening steady disappearance of areas of foreshore – and mangroves are particularly vulnerable – much will never be known.

Sitting quietly on the seaward-facing bund with a pair of binoculars is the most rewarding way to investigate the burrowing crabs of the mangrove mud. Wait a few minutes and Hong Kong's largest fiddler crab, found only at Mai Po, will emerge. Males of *Uca arcuata* may be up to 4 cm across the carapace which is brilliantly coloured red and black. The huge chela (claw) of the male is similarly a brilliant red and stillness on your part will reward you in summer with the sight of gargantuan battles as each male in the colony defends his favoured burrow and the courtship displays of the amorous males. They wave their chela high to attract the smaller, less romantic, females who seem more intent on feeding; using their two tiny chelae, each morsel of mud being picked up and pushed into the mouth located between maxillipeds opening and closing like lift doors.

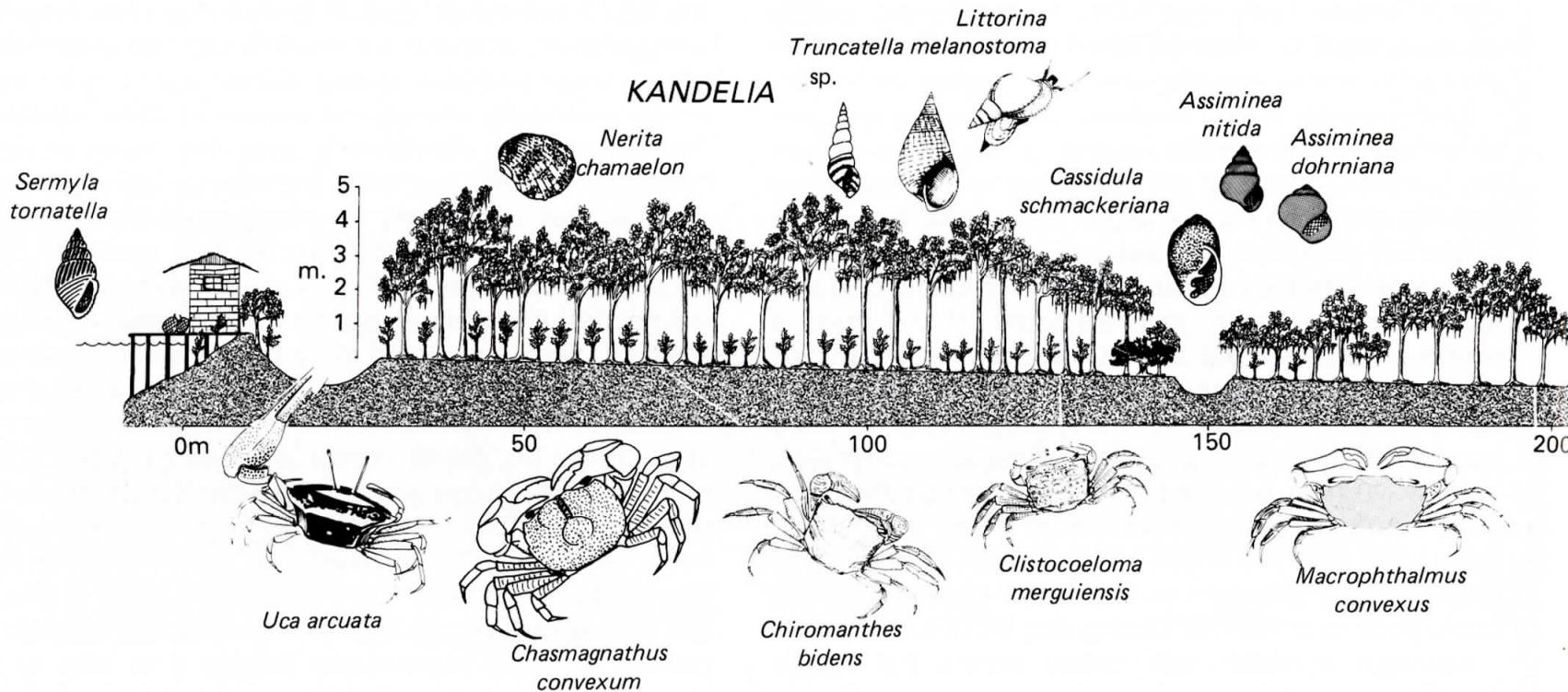
Amongst a fiddler crab colony occurs the equally

colourful but solitary crab *Chasmagnathus convexum* with a heavy green back and brilliantly purple, red and blue, equal chela. This crab too is a mud feeder but undoubtedly also forages away from its burrow on leaf litter and other decaying organisms. *Chiromanthes bidens* is smaller, maybe 2 cm across the carapace, and is seemingly always fleet-footed, rushing from burrow to trees. A metallic green back is countered by bright red chelae. Soh Cheng Lam has described a second species of *Chiromanthes* – *C. maipoensis* – recorded only from the Mai Po marshes. Like *C. bidens* it is a fast runner with different carapace dimensions, but also green with more orange and blue chelae. *Clistocoeloma* is a small brown crab often sharing the burrow of *Chiromanthes*. *Macrophthalmus convexus* is secretive, living in long horizontal burrows but with enormously elongate eye-stalks so that, buried, only the eyes project above ground to detect danger before the crab will emerge. *Uca vocans* is a low-zoned fiddler the casual visitor to Mai Po will not see. It inhabits sloppy mud at the seaward fringe. Marbled green and brown along the carapace, the male chela is variably white to pink. Final mention, and a word of caution, must be made with regard to the predatory crab of Mai Po. *Scylla serrata* is the large green crab, found for sale, securely bound, in Hong Kong's markets. It is almost wholly restricted to mangroves (as are the other crabs) but builds cavernous burrows along the channel banks of the deeper mangroves. Mud skippers too build large burrows but *never* put your hand inside a burrow of these dimensions hoping it is that of a

mud skipper because the massive chelae of a big *Scylla* are formidable weapons. In fact if you do wish to examine the crabs in more detail, do not bother digging for them (a total and frustrating waste of energy, and also damaging to the habitat), but rather squat behind the burrow with a slender but solid spiked stick in hand and quietly wait for the crab to emerge at the burrow entrance.

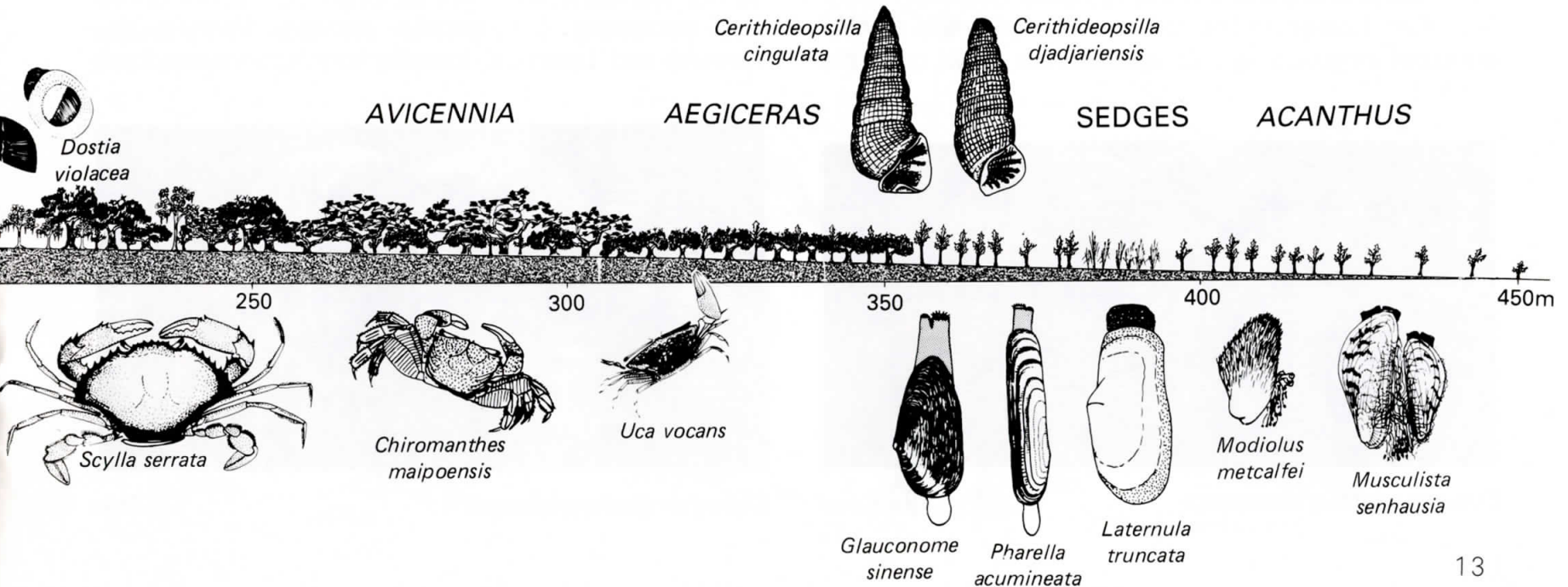
When it does the stick can be pushed through the mud into the burrow behind thereby blocking his normal means of retreat.

The crabs provide the colour in a tropical mangrove and the major interest because of their purposeful activity and interactions one with the other. The Mollusca, probably the second most important group in a man-



grove, are more sedate in their life style. *Littorina melanostoma* is the common snail of the foliage; either green or brownish in colour it is characterized by a dark spot inside the mouth of the shell. A small, tall-spined snail – *Truncatella* – also occurs on the mangrove stems. Under the leaf litter on the forest floor occur snails with a more terrestrial affinity, air breathing pulmonates of the genus

A transect through the seaward fringe of mangroves at Mai Po showing the distribution of the various dominant species of plants. Common mangrove animals are also illustrated.



Cassidula with a characteristically sculptured mouth to the shell. In other mangroves of Hong Kong these snails are more diverse and numerous, but are largely absent from Mai Po because the landward fringe mangroves (their usual habitat) have been cut. In Mai Po they are collectively replaced by the pond snail *Sermyla tornatella*. The mud, however, is dotted by the small, plump and dull brown snail *Assimineia dohrniana*. A second species, *A. nitida*, rather taller, can also be found on the ground or on the trees. In Mai Po, *Nerita chamaelon*, its specific name suggesting the variety of colour morphs this species can occur in, lives on the stems and amongst the roots. The dark brown to black *Dostia violacea* with a red shell aperture is a true mangrove nerite, occurring under leaf litter. Lower on the shore two mud snails *Cerithi-deopsilla cingulata* and *C. djadjariensis* crawl over the

mud, feeding. They too are dull brown and separated by the structure of the shell aperture. On the seaward fringe, the stems and 'droppers' of the mangroves are thickly encrusted with the barnacle *Balanus amphitrite*.

The bunds of the Mai Po marshes are scattered by bleached shells dug up by dredgers in the reclamation process. Few of these shells, representative of more offshore communities, naturally occur in the mangrove. Window pane oysters and heavy ark shell cockles abound, but in the mangrove only a few buried species are characteristic. Two, the mussels *Musculista senhausia* and *Modiolus metcalfei* are shallow burrowers byssally attached to roots in the latter and forming a dense, matted colony, further offshore, in the former. The burrowing *Glauconome chinese*, *Pharella acuminata* and *Laternula truncata* live rather deep, how-



Chasmagnathus convexum

Y.K. Chan

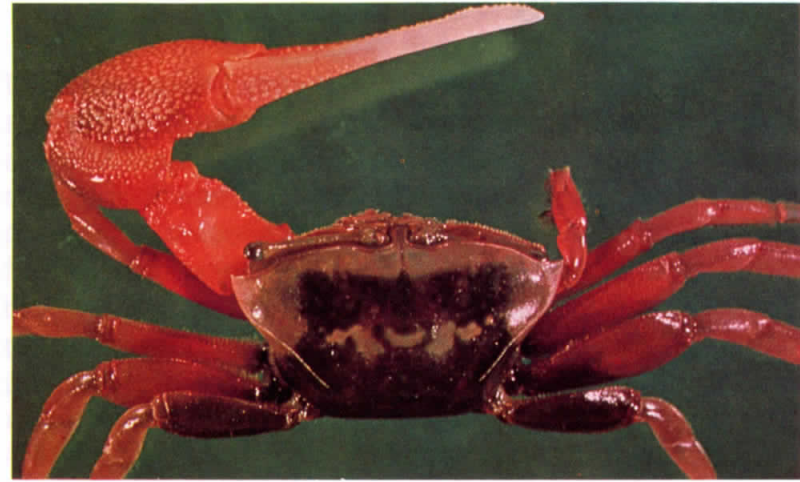


Chiromanthes maipoensis

Y.K. Chan

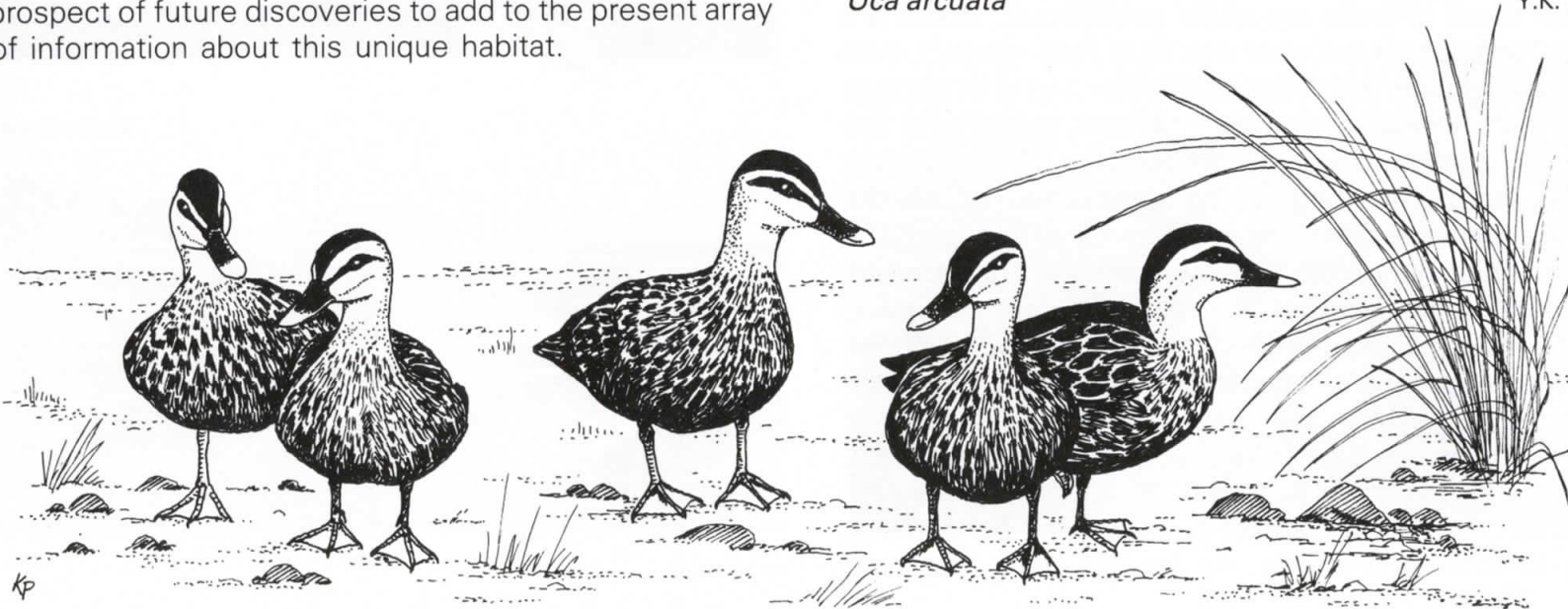
ever, the first two species being able to rebury with ease. *Laternula* is different and one of Hong Kong's most exotic mangrove species. The siphons are tipped by nine complex eyes that at least perceive shadows thrown by wading birds causing long tentacles to accumulate mud over the burrow entrance to avoid detection. The shell is paper thin and cracked transversely about the mid line effecting an unusual means of collecting food.

Moths, ants, other insects and spiders occupy the canopy leaves but few are true mangrove associates, many occurring with equal opportunism, elsewhere. Similarly, worms of many origins abound in the mud but our knowledge of these is incomplete. The Mai Po marshes has yet to reveal many of its secrets – a prospect of future discoveries to add to the present array of information about this unique habitat.



Uca arcuata

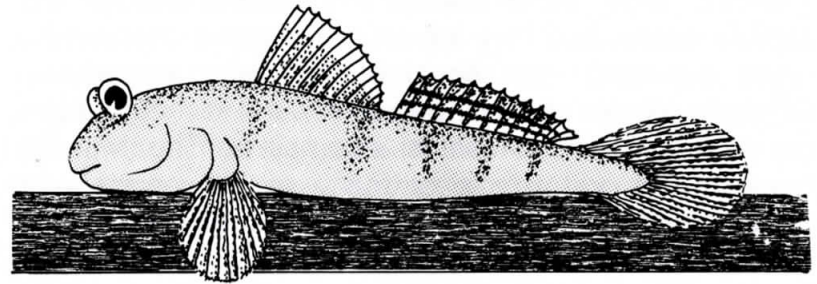
Y.K. Chan



MUD SKIPPERS

Mud skippers are gobioid fishes highly characteristic of all mangroves but abound in Mai Po because of the soft mud. *Periophthalmus cantonensis* is dominant, with the larger *Boleophthalmus boddarti* low-zoned and less often seen on dry land, but no research has been undertaken on these remarkable animals in Hong Kong. They live in deep holes in the mud and emerge to feed when the tide is low. As you walk along the bunds the mud skippers flee your approach, wiggling and hopping with great agility. Eventually they skitter over the water surface itself. By modifications to the mouth and the provision of a rich blood supply to the wall of the buccal cavity, these animals are quite amphibious. Males are bigger and, scattered over the mud flats, protect their territory, fighting both with each other and with hapless crabs that armour their way into their territory. In the breeding season, males attract females by raising their fan-like dorsal fins and raising themselves up on the arm-like pectoral fins. Once a female is seduced she accompanies him to the burrow where the eggs are laid. The pair remain together, the female usually occupying the burrow, the male defending it. In the mud skipper, the unusual means of locomotion comes about from the pectoral fins which are turned forwards (instead of backwards as in a typical fish), so that they act as arms. Because of this, mud skippers can not only move with great agility over land, and of course swim, but can also cling to roots and stems. As for the crabs, the mud

skipper watcher can be no better advised than to seat himself comfortably near a group with a pair of binoculars and be entertained by this mangrove comedian.



Mud skipper

THE OYSTER INDUSTRY

The intertidal mud flats of Deep Bay have been used for oyster culture for at least 170 years and possibly for as long as 700 years, the oysters being cultivated by 'bottom-laying'. Concrete slabs or old oyster shells are used as 'cultch' and placed on the muddy bottom to collect oyster larvae (spat). The set oysters are then left to grow in the breeding ground for one or two years before being transferred to a deeper fattening ground for an additional period of one or more years prior to harvesting. The decline in the weight of oysters produced each year in Deep Bay, from around 1,000 tonnes in the late 1950s to but a few hundred tonnes in recent years, is probably the result of reduced manpower as



P.S. Wong

young people have turned to more profitable employment, as well as changing environmental conditions in the Bay.

There has been growing concern among oyster farmers about pollution levels in Deep Bay and this has resulted in farmers moving well grown oysters into ponds for up to six months prior to selling them. Ponds for keeping oysters and fish, such as mullet, have increasingly been constructed in areas of dwarf mangrove on the edges of Deep Bay. In 1973 such a pond was built in the mangrove at the north end of the Mai Po marshes. A further area of mangrove was impounded there in 1978 and most of the mangrove around the Yuen Long Creek has similarly been destroyed.



P.S. Wong

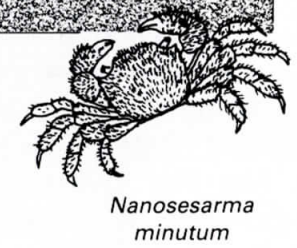
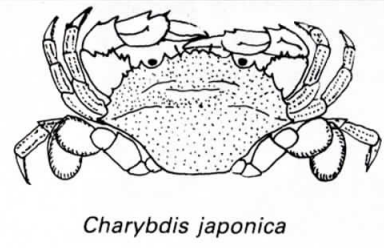
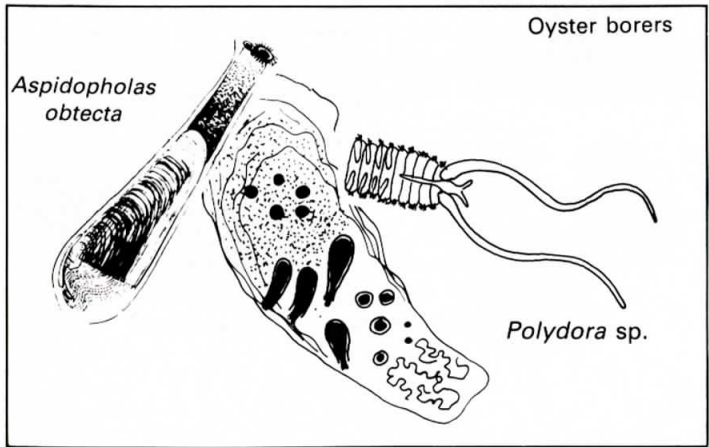
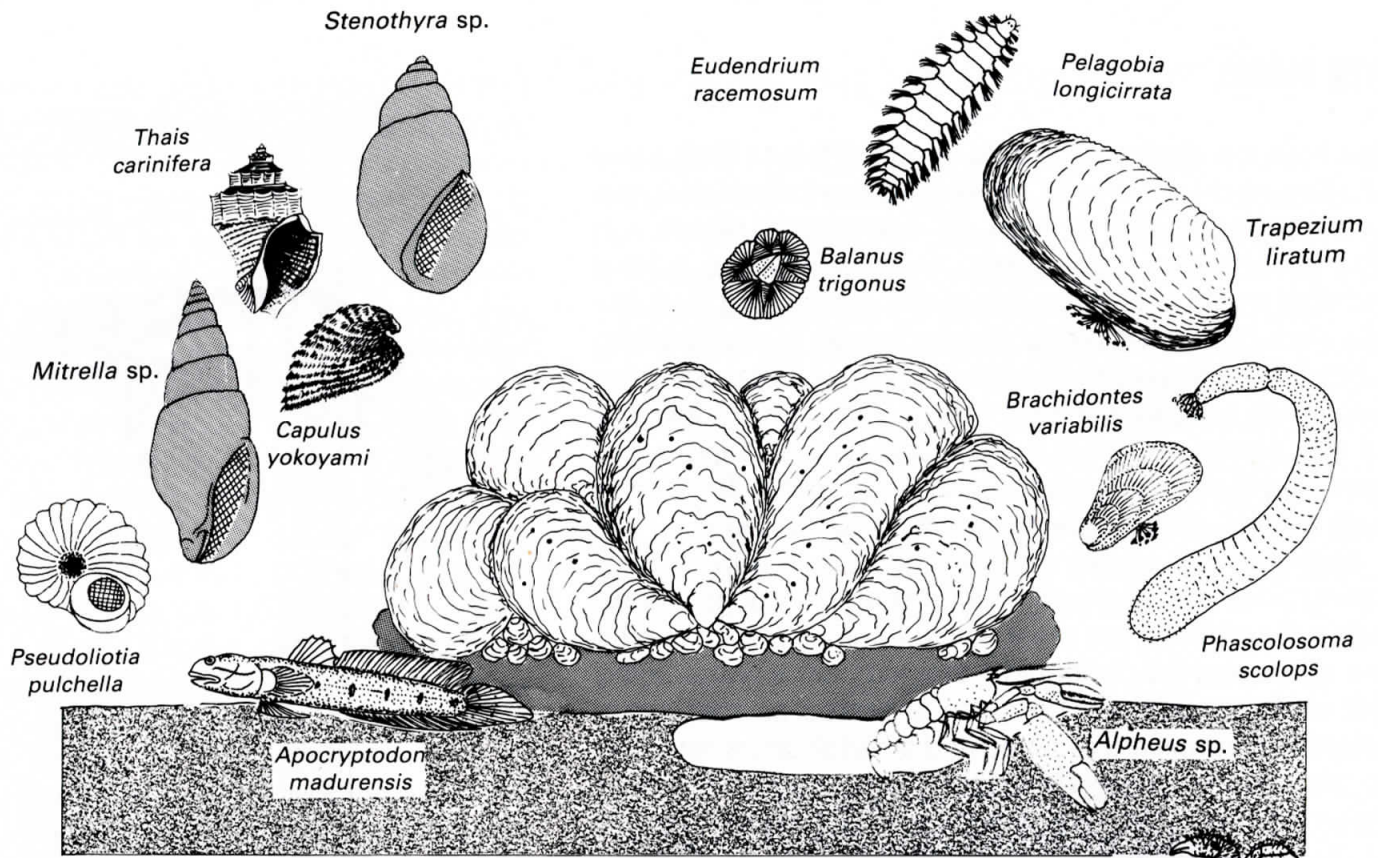
THE OYSTER BED FAUNA

The artificial propagation of oysters on the shore beyond the mangroves and within the channels draining the area has created an artificial habitat and enhanced the species diversity of the whole area. The solid surface of the oysters and their cultch allows attachment by other organisms, including barnacles (*Balanus trigonus*), hydroids (*Eudendrium racemosum*) and triangular, byssally attached bivalves (*Trapezium liratum*, *Brachidontes variabilis*). Small polychaete worms (*Pelagobia longicirrata*) live in the mud which accumulates in the oyster shell crevices and snails (*Stenothyra*, *Mitrella*, *Pseudoliotia*) crawl over the shells. The big, conically-stepped snail, *Thais carinifera*, is the major oyster predator, chipping away at the shell until the tissues are exposed. The 'hairy' *Capulus* shell discreetly moves up to the edge of the shell, so that when the oyster opens, it can stealthily feed on the flesh with a muscular proboscis. Further offshore the oysters are the prey of the small ray *Aetobates flagellum*.

The 'peanut worm' *Phascolosoma scolops* lines the crevices of oyster shells, feeding on the mud with a long proboscis, tipped with a terminal crown of tentacles.

Under the cultch or empty oyster shells live crabs such as the hairy *Nanosesarma minutum*, the smoothly oval *Heteropanope eucratoides* and the fierce *Charybdis japonica*, the latter heavily armoured and protected by spines. Small gobioid fishes too live under the stones, e.g. *Apocryptodon madurensis* and the snapping 'pistol' shrimp *Alpheus*. Here a single chela is enlarged and with an opposable digit it can produce clicking sounds resembling the snapping of human fingers. This is used in territory defence, but battle is pursued by much pushing and shoving – the biggest one usually winning. The whole mangrove, if you stand quietly, seems, on occasion, alive with the sounds of miniature pistol shots as these shrimps, in warning and defiance, snap their fingers at each other.

The oyster shells themselves are very friable and the meat of reduced bulk because of a remarkable boring community. The calcium carbonate oyster shell is relatively soft and a yellow sponge chemically erodes it. A burrowing polychaete, *Polydora*, with two long tentacles projecting from its burrow also bores the shells but the most damage is done by a mechanically boring bivalve, *Aspidopholas obtecta*, that on occasion positively riddles the oyster.

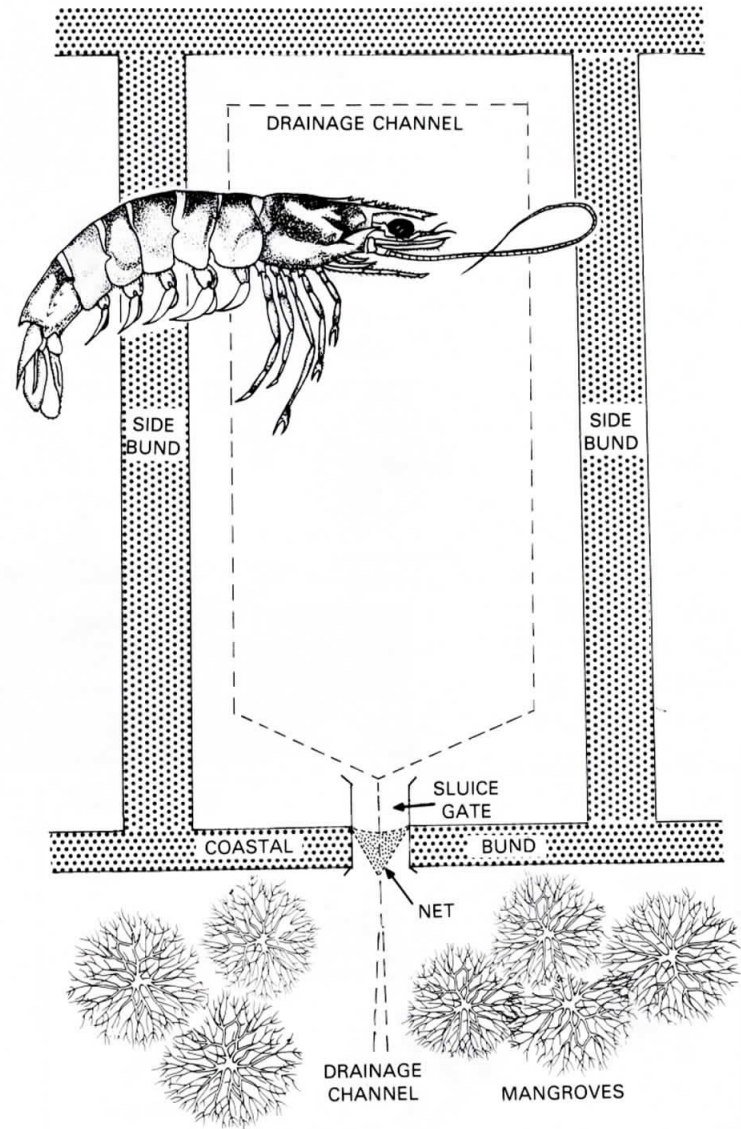


KEI WAIS

Kei wais are shallow ponds formed by impounding areas of mangrove with a mud bund. There are deep drainage channels around the edge of each pond which run through a sluice to the sea. Such ponds are a long established and characteristic method of fishing throughout Asia and have probably been used in Hong Kong since the early days of human settlement. Essentially the fishermen are capitalizing on the normal high productivity of the mangrove environment and natural supplies of 'seedlings' of commercial organisms directly from their wild stocks, thus reducing costs to a minimum.

Harvesting is usually done at night, during periods of spring tides and preferably when there is a bright moon when the shrimps are most active. A net is placed across the sluice and the pond partly drained, some water being left in the channels. The catch is sorted so that large, saleable shrimps are retained and small shrimps returned to the pond to grow. The pond is reflooded by the next incoming tide, the net again being placed across the sluice. The mesh of the net is sufficient to allow passage into the pond of larval shrimps but adults and potential predators are caught. In this way the operator has reasonable control over the stock in his pond.

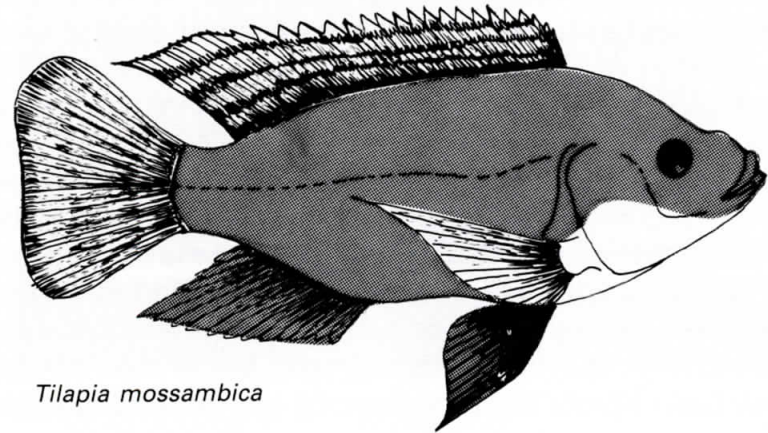
At Mai Po, shrimps of the genera *Penaeus* and *Metapenaeus* are usually harvested between the first and sixth, and sixteenth and twentieth days of the third to eleventh lunar months, there being about 90 such harvests each year.



In recent years there has been a change from this traditional form of shrimp fishing to culturing fish such as mullet (*Mugil* sp.) and *Tilapia*, and shrimps may now account for only about 40% by weight of the harvest. It has been estimated that the *kei wais* at Mai Po may yield up to about 400 kg of saleable shrimps and fish each year – a good return for the operator as he has not invested money in feeding his stock. In addition, oysters are now grown in the ponds enhancing profit. The increasing pressure for developmental land in Hong Kong has meant however that a farmer gets a better return by using ponds for intensive fish culture even though this requires a high input of bought food for the stock, resulting in the disappearance of many traditional *kei wais*. Most of those at Mai Po, being controlled by strict conditions attached to the Crown Land Permit, have remained, but often in a neglected state. They have become choked by vegetation and the reed *Phragmites* has been quick to invade open areas. Without strict management of the *kei wais*, not only will the area lose much of its ornithological interest, but Hong Kong will have lost a traditional fishing method and thus a part of its heritage.

FISHES OF THE *KEI WAIS*

The salinity of the *kei wais* waters varies considerably (between 2.5–29.5%) enabling survival and stocking of but a relatively few fish species. The commonest fish is the *Tilapia mossambica* (introduced from East Africa), but a close second is the striped mullet (*Mugil cephalus*). Fry of the latter are caught in the waters of the Deep Bay and grown on to marketable size in the ponds. The eel *Anguilla japonica*, the striped tiger fish (*Therapon jarbua*), black and yellow-finned breams (*Mylio macrocephalus* and *M. latus*), sea perch (*Lateolabrax japonicus*) and blind sea bass (*Lates calcarifer*) as well as the scat (*Scatophagus argus*) and the sea catfish (*Plotosius anguillaris*) are all commonly harvested from the ponds.



Tilapia mossambica

BIRDS

The Deep Bay area is deservedly well known for its birdlife, as the wetland habitats offer rich feeding sites for many of the larger and more spectacular species as well as a multitude of smaller birds. Of the 400 species currently known in Hong Kong, about 250 have been recorded in the Deep Bay area, of which over 100 are rarely, if ever, found elsewhere in Hong Kong. Although Hong Kong has such a varied avifauna only some 80 species are known to breed regularly and most species are migrants, breeding elsewhere and either visiting Hong Kong for the winter or passing through in spring and autumn between wintering grounds to the south and breeding areas to the north.

Egrets and herons are features of the Deep Bay area throughout the year. In the early 1960s there was a large egretty (breeding colony) at Yuen Long but this was deserted when factories were built nearby, smoke from which poured through the wood. A small egretty was present at Au Tau for several years in the early 1970s until the nesting trees were cut down. Another egretty was formed in the wood below Lok Ma Chau police station in 1970. Although apparently undisturbed at this site some birds moved to the banyans, pines and bamboos of the small *fung shui* wood beside the road at Mai Po in 1974. By 1977 all of the egrets breeding in the Deep Bay area were concentrated at this site, apparently oblivious to the traffic rushing past below their nests. The Little Egrets (*Egretta garzetta*) are the first to com-



Little Egret

M.L. Chalmers



Great Egret

M.L. Chalmers

mence nest building in early March, the Cattle Egrets (*Bubulcus ibis*) and Chinese Pond Herons (*Ardeola bacchus*) being a little later. It is of interest that breeding at this site is consistently two to three weeks ahead of birds using the only other egretty in Hong Kong at Sha Tau Kok.

The Little Green Heron (*Butorides striatus*) and Yellow Bittern (*Ixobrychus sinensis*) are not communal nesters but breed in isolated pairs in the mangroves and reed beds respectively. Both species leave the area during the winter, the Little Green Heron moving inland to live beside streams in the hills, while the Yellow Bittern apparently moves south to Indochina. In contrast the Night Heron (*Nycticorax nycticorax*) is found throughout the year at Mai Po. By day it roosts in the mangroves and at dusk flies out to feed, its loud 'kwok' call carrying far over the marshes. Winter visitors include the Grey (*Ardea cinerea*) and Purple Herons (*Ardea purpurea*) and the Great Egret (*Egretta alba*).

Although the White Stork (*Ciconia ciconia*) looks like a heron it is not closely related. In recent winters several White Storks have visited Deep Bay – the Asian population is considered to be endangered and it is pleasing to note that all of those recorded have been juveniles.

In summer the reed beds and mangrove areas are alive with the songs of the small Yellow-bellied (*Prinia flaviventris*) and Brown Wren-warblers (*Prinia subflava*), both resident species which build small domed nests in the vegetation. The Yellow-bellied also breeds throughout Hong Kong in areas of coarse grass and scrub but the



Pair of Falcated Teal

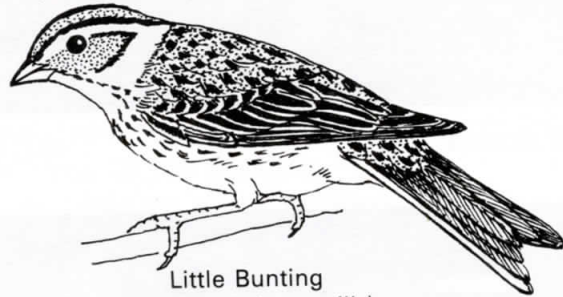
M.L. Chalmers



Male Shoveler

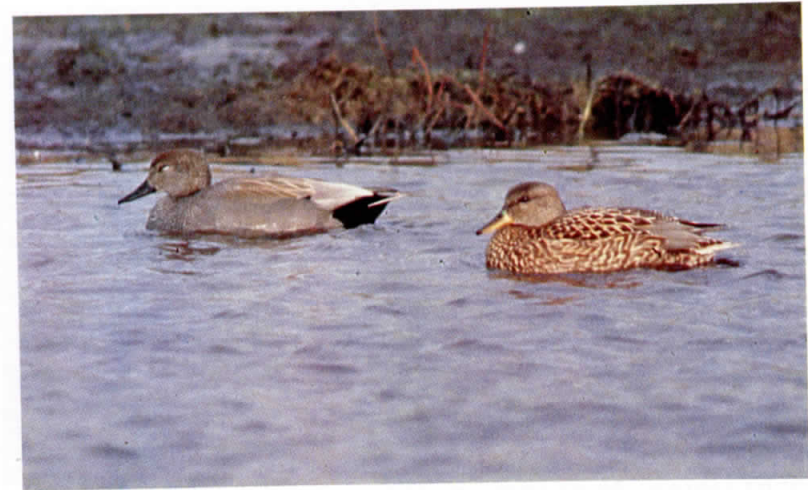
J. Edge

Brown is largely confined to Deep Bay where it builds its well anchored nest in the reed beds. The Yellow-bellied builds a more messy, less secure nest which needs the support of stronger vegetation, and is less suited to reed beds. In autumn the reeds provide fishing perches for the brightly coloured Common Kingfishers (*Alcedo atthis*), many of which are seen at this time of year. In winter the fluffy seed heads provide food for flocks of Masked (*Emberiza spodocephala*) and Little Buntings (*Emberiza pusilla*).



Little Bunting
(*Emberiza pusilla*)

In winter, flocks of ducks present a spectacular sight. Formerly, when paddy was grown around Deep Bay, ducks such as Yellow-nib (*Anas poecilorhyncha*) would fly inland at dusk to feed on fallen grain among the stubble and provided good sport for hunters. With the loss of paddy and increasing hunting pressure, numbers of ducks visiting the area dropped but in response to a ban on hunting in recent years numbers have again increased. Species such as Pintail (*Anas acuta*), Shoveler (*Anas clypeata*), Gadwall (*Anas strepera*) and Pochard (*Aythya baeri*) are now seen more frequently than before



Pair of Gadwall

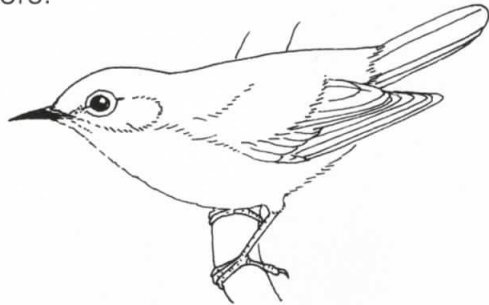
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Male Pochard

D.S. Melville

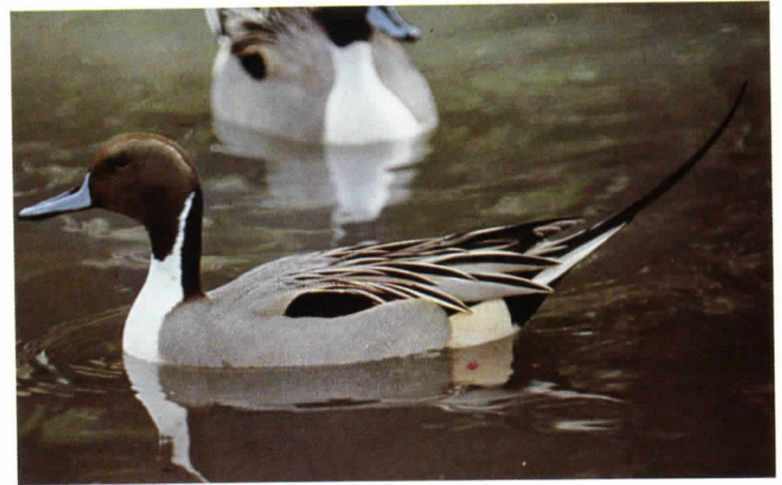
and there have been very marked increases in those species which feed on the intertidal mud flats such as Shelduck (*Tadorna tadorna*) and Teal (*Anas crecca*), over 3,000 individuals of the latter species being seen in recent winters.



Japanese White Eye
(*Zosterops japonica*)

Also out in the Bay can be seen fish-eating species such as Dalmatian Pelicans (*Pelecanus crispus*) and Cormorants (*Phalacrocorax carbo*). In recent winters the Cormorants have taken advantage of the abundant food supply in commercial fish ponds where they are not infrequently seen. Cormorants are the only birds to have benefited from the development of such ponds since the steep sides and deep water do not provide feeding opportunities for other species.

Up to 1,000 Black-headed Gulls (*Larus ridibundus*) have been counted in Deep Bay in winter and a patient observer may be rewarded by finding a few of the rare Saunders' Gulls (*Larus saundersi*) – somewhat smaller than the Black-headed Gull, this species is of great interest in that its breeding grounds remain undiscovered



Two Male Pintail

J. Edge



Male Teal

M.L. Chalmers

although it is thought to nest in China. In winter it lives in estuaries along the coasts of south and east China and thus is vulnerable to pollution by industrial effluent.

Other winter visitors include birds of prey such as the Eastern Marsh Harrier (*Circus aeruginosus*), which hunts over the reed beds and pools, preying on small birds, and the Osprey (*Pandion haliaetus*) which catches fish by plunging feet-first into the water. The scavenging Black Kite (*Milvus migrans*) is resident in Hong Kong but numbers increase during the winter when birds arrive from further north, along with a few Spotted (*Aquila clanga*) and Imperial Eagles (*Aquila heliaca*).

Shorebirds are generally scarce in the winter, the only species found in any abundance being Spotted Redshank (*Tringa erythropus*), Kentish Plover (*Charadrius alexandrinus*), and Avocet (*Recurvirostra avosetta*). However large numbers pass through Hong Kong in spring and autumn and it is not unusual to see mixed groups of 25 species in spring, including sand-plovers, stints and the rare Spoon-billed Sandpiper (*Eurynorhynchus pygmeus*) and Asiatic Dowitcher (*Limnodromus semipalmatus*). Most of the birds feed in Deep Bay at low tide, roosting at high tide in drained ponds. Formerly, when the *kei wais* were better managed, large numbers of shorebirds visited them and they were able to continue feeding in the shallow water at times when the water was too deep in the Bay. At such times they afforded excellent opportunities for observation.

Recent studies of individually marked shorebirds have begun to reveal something of the great migrations which



Dalmatian Pelican

D.S. Melville



Little Green Heron

D.S. Melville



Spotted Eagle

M. L. Chalmers

these birds undertake each year. The Curlew Sandpiper (*Calidris ferruginea*), which is a small bird weighing about 55 g, breeds in the far north of Siberia and winters throughout Southeast Asia to Australia. One Curlew Sandpiper marked near Melbourne was caught at San Tin and a Red-necked Stint weighing only about 30 g marked at San Tin was found in Tasmania – both movements of



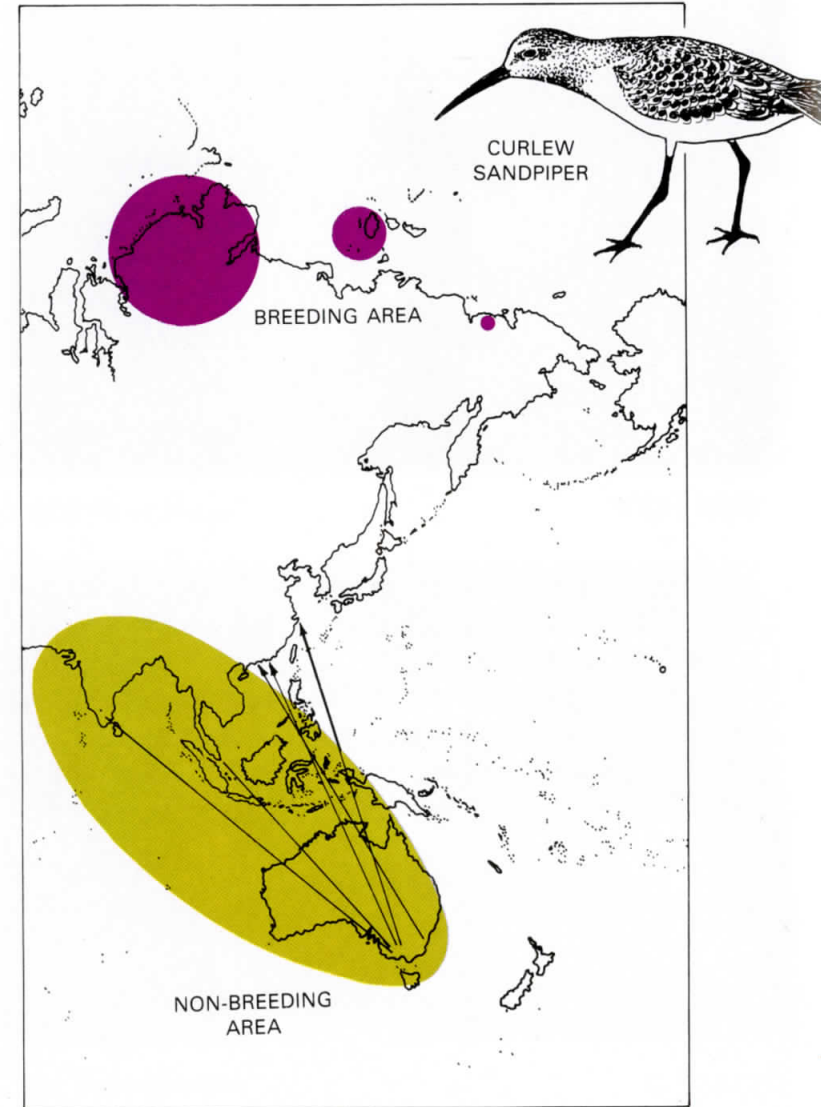
Common Kingfisher

J. Edge

over 7,000 km. There is growing evidence to suggest that the coast of South China may be an important area for shorebirds which have wintered in Australia to feed and build up fat reserves to serve as fuel when they continue their migration northwards. The need to conserve suitable feeding areas is of international importance.

BIRD FEEDING STRATEGIES

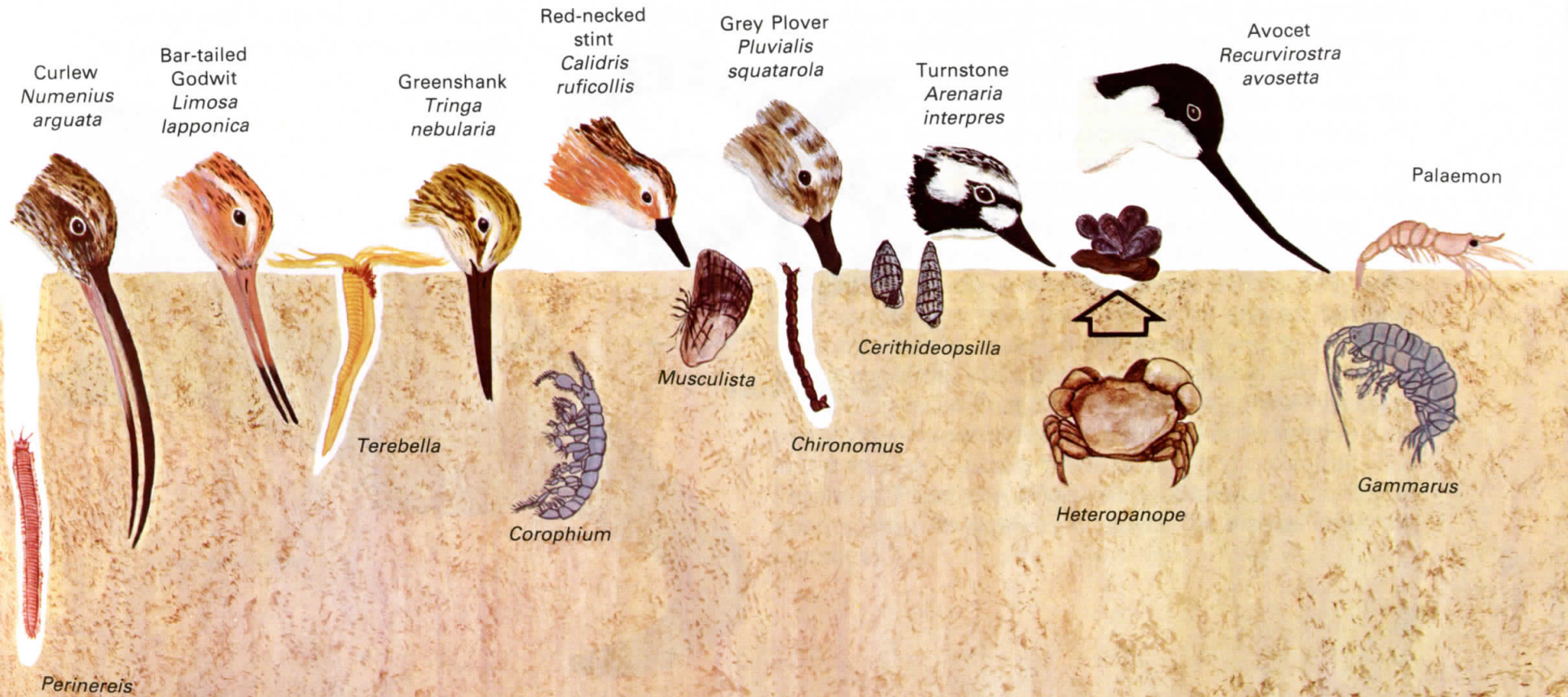
The large number of shorebird species which occur in Deep Bay are able to coexist in the same habitat by having different feeding habits, by feeding on different prey and/or occurring at different times of the year. The Curlew (*Numenius arquata*), which is a winter visitor, has a long bill (155 mm) and probes deep into the mud to find worms such as *Perinereis*, its large size also allows it to take fish such as mud skippers. The Bar-tailed Godwit (*Limosa lapponica*), is a passage migrant – having a shorter bill it can not probe so deep, and feeds on worms, *Corophium* and probably on small bivalves. It is of interest that the females of this species have longer bills (110 mm) than the males (83 mm), suggesting that they may be able to utilize different prey resources, although studies elsewhere have not shown any difference in diet. Both the Curlew and Bar-tailed Godwit rely largely on a sense of 'touch' to locate their prey. In contrast the Grey Plover (*Pluvialis squatarola*) uses its large eyes to find most of its prey and feeds close to the surface on animals such as young *Certhideopsilla* and *Assimineia*. The Greenshank (*Tringa nebularia*) often feeds in shallow water by dashing about stabbing its bill at shrimps such as *Palaemon*, and it also probes for worms such as *Terebella*. The Avocet (*Recurvirostra avosetta*) also feeds on small shrimps and insects in shallow water and liquid mud moving its head from side to side and using its curious up-turned bill like a scythe.



The Turnstone (*Arenaria interpres*), as its name suggests, usually feeds by searching for small crabs, e.g. *Heteropanope* and *Gammarus*, under stones and among seaweed, and, in Deep Bay, probably feeds mostly around the oysters beds. The short-billed Red-necked Stint (*Calidris ruficollis*) feeds on small chironomid larvae,

pecking at the surface of the mud with a stitching action rather like a sewing machine, while the Spoon-billed Sandpiper (*Eurynorhynchus pygmeus*), which feeds on similar prey, uses its spatulate bill to collect prey from the surface of the mud like a vacuum cleaner.

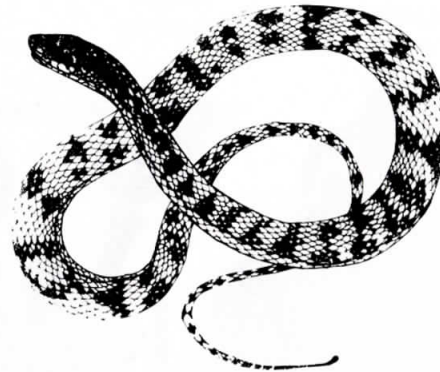
Shore birds and their potential prey in Deep Bay



REPTILES

Snakes have been little studied in the area but some of the more common species recorded here include the Common Rat Snake (*Ptyas mucosus*), Many Banded Krait (*Bungarus multicinctus*) and Chinese Cobra (*Naja naja*). The most interesting species is the slate grey with

black patterning Mangrove Snake (*Enhydris bennetti*), which has a very limited distribution in the coastal areas of Fujian, Guangdong and Hainan. In Hong Kong most records are from the Deep Bay mangroves, but there have been occasional sightings from mangrove areas on Lantau. It is a very little known species which is thought to feed on mud skippers.



Mangrove Snake

MAMMALS

The great increase in human pressure on the Deep Bay area in recent times has resulted in the loss of larger mammals such as the Common Otter (*Lutra lutra*), which was plentiful in the area at least until the 1940s. It is probable that the Crab-eating Mongoose (*Herpestes urva*) occurred occasionally up to the early 1950s although this species generally prefers freshwater habitats.

The largest mammal present is the Large Bandicoot Rat (*Bandicota indica*) which appears to be numerous,



Common Otter



Bandicoot Rat

living in extensive and complex burrow systems in the *kei wai* bunds at Mai Po – entrances to the burrows being readily recognizable by the large mounds of earth 'pellets' dumped nearby. The Norway or Brown Rat (*Rattus norvegicus*) is common, especially around the villages and feed-stores close to the duck and fish ponds. The House Shrew (*Suncus murinus*), as its name suggests, is usually closely associated with man but has been found away from human habitation on bunds between *kei wais* at Mai Po. These smaller mammals undoubtedly provide a food source for snakes, but their nocturnal habits make them generally unavailable to predatory birds, owls being very scarce in the area.

The Dog-faced Fruit Bat (*Cynopterus sphinx*) has occasionally been seen at Mai Po but there is no suitable food in the area as it usually feeds on figs and other fruit. The Japanese Pipistrelle (*Pipistrellus abramus*) is not infrequently seen at dusk as it hawks for insects over the marshes.

WHERE TO GO

At present permits to visit the Mai Po Marshes can be obtained upon written application to: The Director, Agriculture and Fisheries Department, 12th floor, 393 Canton Road, Kowloon. Once you have obtained your permit, entry into the marshes is from Mai Po village, via Pak Hok Chau where there is a car park and a Nature Warden's post. Check in here, with a map of the marshes and a tide table.

In Mai Po, two major wildlife educational resources are available. The first concerns the side bunds of the *kei wais* which because of their elevation, flanked by tall reeds and mangrove trees, provide natural 'hides' for the bird watcher. Quietness and a stealthy pace with regular stops to peer through the flanking vegetation, will bring the observer in close proximity to birds which swim on the open water (ducks, Coots and Little Grebes), birds nesting in the mangroves and reeds (Yellow Bittern and Wren-warblers) and birds wading and feeding in the shallow waters (egrets and sandpipers). Here, you can closely approach the wary Redshank (*Tringa totanus*) better known as 'the watchdog' of the marshes, its whistling alarm sounding the presence of the uncautious.

The seaward road is raised above the level not only of the fish ponds, but more importantly also overlooks the foreshore mangroves. Less discerning of danger than birds, mud skippers and crabs readily accept any large



B.S. Morton

object in their vicinity (you) providing that it does not make sudden movements. Sit quietly at the time of low tide with binoculars and not only will you be rewarded by the birds in the mangrove but the crabs and mud skippers will soon emerge from their burrows to entertain you. The recent construction of a security fence along this road has resulted in access to the edge of the seaward mangroves being restricted. However the southern end of the marsh remains unfenced and offers ample opportunity for the observer of the mangrove fauna.

HAU HOI WAN
(DEEP BAY)

RESTRICTED
ACCESS AREA

MANGROVES

NEW FISH
PONDS

SHEA SHAN

KEI WAIS

TAI LONG KEI

WWF CENTRE

POLICE POST

NATURE
WARDEN'S
POST

Pak Hok
Chau

Ponds

Wo Shi
Wa

Tai Shang

SHAM CHUN RIVER





Knot flying

M.L. Chalmers

WARNING

The mud of the foreshore mangroves is *very* soft. It is inadvisable to try to enter the mangroves on foot as you will quickly sink in deeply to beyond your knees. The larger mangrove animals can be easily seen from the edge.



B.S. Morton



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WILL THE MARSHES SURVIVE?

The growing population of Hong Kong and the increasing amount of leisure time which it enjoys place mounting pressure on the countryside both directly, through urbanization, and indirectly, through outdoor leisure activities. Already many people from the urban centres of Hong Kong and Kowloon visit the countryside (in 1981 an estimated 8 million people visited the Country Parks) and the development of new towns in rural areas will result in the remaining countryside being more readily accessible to an increasing number of people – the development of the northwest New Territories around Yuen Long could result in a population of one million in this area. The need to cater for the recreational requirements of these people is urgent and has resulted in about 40% of the land area of the Territory being established as Country Parks by the Government. Additionally, environmental and ecological studies are now included in school curricula. These subjects are best taught in the field and the one Field Studies Centre at Sai Kung which has been created by the Government is already unable to meet the large demand for student places. There is a very real need to establish wetland conservation areas in Hong Kong.

Sir Peter Scott, founder of the World Wildlife Fund, first proposed, in 1964, that an educational nature reserve be established in Deep Bay and this recommendation has subsequently been endorsed by many naturalists. However conservation measures to date at Mai Po



B.S. Morton

have been little more than holding actions which have not been able to prevent change to the environment through neglect or enabled any positive management of the area for the benefit of wildlife.

Much of the area formerly proposed for reserve status has already been destroyed or degraded to such an extent that it no longer justifies inclusion, but the *kei wais* at Mai Po and adjacent areas of mangrove and intertidal mudflats still retain much of their former value and present the last opportunity to conserve such an area for the educational and recreational enjoyment of the present and future generations of Hong Kong people.

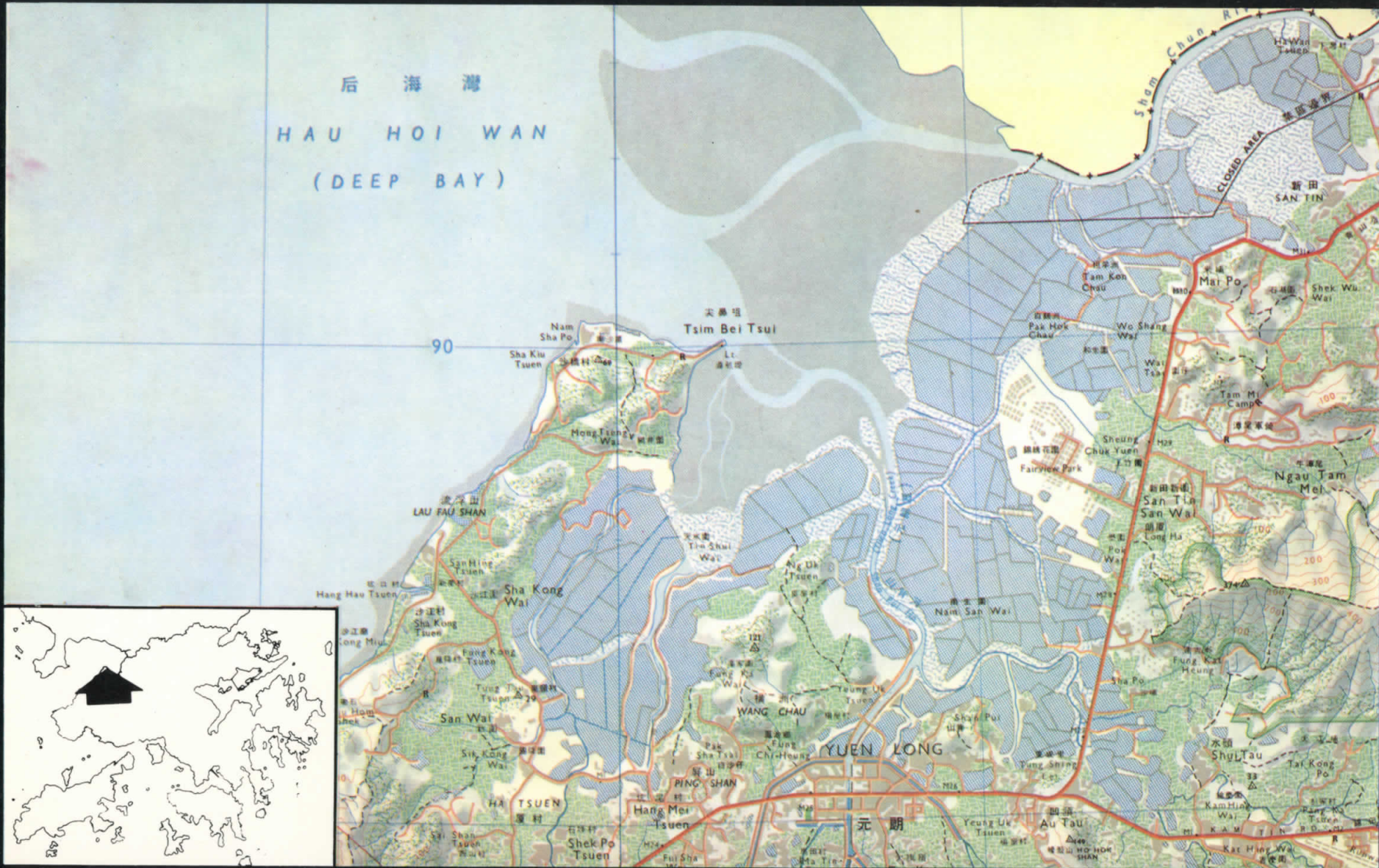
A recent report by S.M. Goodall of the Wildfowl Trust,* Slimbridge, has unequivocally recommended that the Mai Po marshes be developed as a Wildlife Education Centre, emphasizing that if the area is to be conserved, steps must be taken *now*. The report also makes major recommendations as to how such a Wildlife Centre could benefit the people of Hong Kong. The centre would have a large collection of tame waterfowl as well as providing facilities for the observation of wild birds in natural surroundings. With facilities for people of all ages, including the handicapped, since, for example, blind people could gain much from the patterns of bird vocalization, such a centre would concentrate on the educational

enjoyment of all. Further facilities in the form of a Field Studies Centre for students and professional ornithologists would provide a back-up, in depth, education programme and, through research, provide a constant source of new information.

During 1983, limited funds became available to the World Wildlife Fund Hong Kong for an initial pilot scheme in the core of the reserve. Herbert Axell kindly provided expert advice and the Government fully supported the project. Work was started in mid-1983. However, if the full Wildlife Education Centre is to become a reality considerable donations are required to save this magnificent wetland.

*Goodall, S.M. 1982. *Report on the Feasibility of Mai Po Marshes as a Wildlife Education Centre*. World Wildlife Fund Hong Kong.

后海湾
HAU HOI WAN
(DEEP BAY)



MAI PO MARSHES