Annex H

Fisheries Impact Assessment

1.1 BASELINE CONDITIONS

This Annex describes the baseline conditions of capture and culture fisheries resources within the Assessment Area. This area was defined in the Study Brief as all sensitive receivers within the North Western, Western Buffer and Southern Water Control Zones (WCZs). On the basis of preliminary information from the water quality assessment, perturbations to water quality are unlikely to extend outside the area presented in *Annex G - Figure 1.1a.* Consequently, this assessment of impacts has focussed on the fisheries resources of this area. Baseline conditions are evaluated based on information from the literature and specific field studies conducted for the purposes of this EIA.

1.1.1 *Literature Review*

The availability of literature on the fisheries resources of the Assessment Area comes mainly from the AFCD 1996-97 Port Survey. The list of relevant reports in the Study Brief has been reviewed along with relevant information pertaining to the fisheries characteristics of the Penny's Bay and East Lantau area.

1.1.2 *Focussed Field Surveys*

Due to the limited literature available for some components of the marine ecosystem, field surveys were considered necessary to fill the information gaps identified and enable a complete and robust assessment of impacts to fisheries to be performed. The findings of the field surveys are presented below as well as an outline of information on fisheries resources based on information gathered through desk-top reviews of available literature.

In Hong Kong, the commercial marine fishing industry is divided into capture and culture fisheries. To assess the capture fishery within the Assessment Area, the most up-to-date information on the Hong Kong fishery was consulted [1]. Information from other relevant studies within the Assessment Area were also reviewed in order to determine if the areas are important nursery and spawning grounds for commercial fisheries [2]. Updated mariculture information was obtained from the AFCD.

2.1 CAPTURE FISHERIES

In 1997, the estimated fisheries production in Hong Kong waters from both capture and culture fisheries amounted to 186,000 tonnes, valued at HK$ 2,459 million [3]. Capture fisheries accounted for 96 % by weight of the total production while the remaining 4 % corresponded to the culture sectors of the industry. Within Hong Kong waters, the highest yields for local fisheries were mainly derived from the eastern and north-eastern coasts [4]. The five most abundant fish species landed by weight from the capture sector were golden thread (*Nemipterus virgatus* 14%), lizardfish (*Saurida* sp 9%), big-eyes (*Priacanthus* sp 5%), scads (*Decapterus* sp 5%) and yellow belly (*Nemipterus bathybius* 4%).

2.1.1 *Fishing Operations*

In 1989-91 AFCD devised a system whereby the waters of Hong Kong were divided up into Fishing Zones [5]. Data was gathered at that time on the catches of the Hong Kong fleet derived from these Fishing Zones. Since this first Hong Kong wide survey, AFCD have updated the information which now indicates that the number of Fishing Zones equates to 189 of which 179 are actively fished by vessels in the Hong Kong fleet [1].

The up-to-date information from AFCD is available for use in this EIA and can be collated to allow an assessment be made of the importance of Fishing Zones in the Study Area to the Hong Kong fishery (*Figure 2.1a*). The designated Fishing Zones within the Assessment Area have been identified and the importance of these zones will be assessed and discussed below.

The Assessment Area within which potential impacts arising from the construction and operation of the proposed Theme Park EIA and associated developments may occur, consists of thirteen Fishing Zones. These zones are found in northern and (eastern Lantau Island *Figure 2.1a* and *Table 2.1a*). Of

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[1] Agriculture, Fisheries and Conservation Department (1998) Port Survey 1996 - 1997.
[2] ERM (1998) Fisheries Resources and Fishing Operations in Hong Kong Waters, Final Report, for Agriculture, Fisheries and Conservation Department, March 1998.
[3] Agriculture, Fisheries and Conservation Department (1998), Annual Departmental Report 1997-1998
[4] ERM (1998) *Op cit.*
[5] Agriculture, Fisheries and Conservation Department (1991) Port Survey 1989 - 1991.

these 13 fishing zones only three fall in some part under the footprint of the two reclamations for the Theme Park (0023 - Yam O, 0002 - Pa Tau Kwu and 0003 - Penny's Bay.

In comparison with other parts of Hong Kong these fishing zones show a low ranking for fisheries production (120 - 189th). Out of the 189 fishing zones in Hong Kong that reported catches Pa Tau Kwu 149 and Penny's Bay 133. The main fishing operations in these areas are by small scale vessels operating gill nets, hand lines and long lines. These vessels originate from three of the home ports of Silvermine Bay, Ma Wan, and Peng Chau. The Pa Tau Kwu and Penny's Bay fishery zones are also ranked as low (the lower third of all fishing zones) for Hong Kong in terms of catch value (*Table 2.1b*). The fishing zone at Yam O ranks as medium (82 out of 189) when compared to other zones in Hong Kong for both catch weight and value. Neither of these three zones recorded any fry capture activities.

Of the other fishing zones in the Assessment Area the more important ones that rank as of high fisheries production (top third of all fishing zones) are Tsing Chau Tsai East, Ma Wan, Peng Chau and Tsing Lung Tau. Fish fry capture activities were reported from Tsing Chau Tsai, Ma Wan, Kau Yi Chau and Tsing Lung Tau. However, none of these four zones can be regarded as important areas for fry production.

The main fish species reported in catches from the Theme Park footprint are of low commercial value including, mantis shrimp, mixed species (juveniles of trash fish species such as pony fish, scad, rabbitfish and sardine), croaker, crabs and sole (*Table 2.1c*). Only one species of medium value are reported from the area those being the sea breams.

Table 2.1a *Area (Ha) and Number of Vessels Operating During 1996 - 1997 in Each AFCD Fishing Zone within the Assessment Area*

Code	Fishery Area	Area (Ha)	Vessels < 15 m	Vessels > 15 m	All Vessels
0001	Fa Peng	297	45	3	48
0002	Pa Tau Kwu	815	63	4	67
0003	Penny's Bay	278	62	1	63
0004	Discovery Bay	354	66	3	69
0005	Tai Shui Hang	202	37	3	40
0022	Sham Shui Kok	532	136	15	151
0023	Yam O	530	116	8	124
0024	Tsing Chau Tsai	170	160	0	160
0025	Ma Wan	419	254	0	254
0027	Peng Chau	542	198	16	213
0028	Kau Yi Chau	1,621	279	16	295
0038	Tsing Lung Tau	219	130	0	130
0039	Tai Lam Chung	370	20	2	23
Total		**6,349**	*	*	*
Total of all Fishing Zones in Hong Kong		**181,791**	**2,352**	**266**	**2,618**
Percentage of Hong Kong Total		**3.49%**	*	*	*

* No values can be calculated for these parameters from the information provided as it cannot be determined whether the vessels reported as operating within one zone are the same vessels that are reported for another zone.

Table 2.1b ***Total Value ($), Adult Catch (kg) and Fry Catch (tails) Displayed on a Total Production, Production (Ha^{-1}) and Rank (Ha^{-1}) Basis for the AFCD Fishing Zones in the Assessment Area***

Code	Fishing Area	Total Production		Production (Ha^{-1})		Rank Production (Ha^{-1})	
		Adult Fish (kg)	Fry (tails)	Adult Fish (kg)	Fry (tails)	Adult Fish	Fry
0001	Fa Peng	12,384	-	42	-	131/189	-
0002	Pa Tau Kwu	16,327	-	20	-	149/189	-
0003	Penny's Bay	11,447	-	41	-	133/189	-
0004	Discovery Bay	14,068	-	40	-	134/189	-
0005	Tai Shui Hang	6,870	-	34	-	140/189	-
0022	Sham Shui Kok	56,329	-	106	-	89/189	-
0023	Yam O	63,009	-	119	-	82/189	-
0024	Tsing Chau Tsai	38,943	7,661	229	44.98	39/189	46/89
0025	Ma Wan	81,988	7,661	196	18.29	48/189	68/89
0027	Peng Chau	239,029	-	441	-	17/189	-
0028	Kau Yi Chau	246,437	22,984	152	14.18	64/189	72/89
0038	Tsing Lung Tau	35,180	7,661	161	35.02	62/189	58/89
0039	Tai Lam Chung	7,908	-	21	-	148/189	-

Table 2.1c ***Top Five Adult Fish (by weight) Caught in Each AFCD Fishing Zone within the waters of the Assessment Area***

Code	Fishing Area	Top Five Fish Caught (by weight)		Commercial Value
		Species	Common Name	
0001	Fa Peng	*Muraenosox cinereus*	Conger Pike Eel	Medium
		Mixed Species	Mixed Species	Low
		Sebasticus marmoratus	Rockfish	Low
		Platycephalus indicus	Flatfish	Low
		Oratosquilla spp	Mantis Shrimp	Low
0002	Pa Tau Kwu	Mixed Species	Mixed Species	Low
		Platycephalus indicus	Flatfish	Low
		Argyrosomus spp	Croaker	Low
		Cynoglossus spp	Sole	Low
		Oratosquilla spp	Mantis Shrimp	Low
0003	Penny's Bay	Mixed Species	Mixed Species	Low
		Argyrosomus spp	Croaker	Low
		Portunus pelagicus	Blue crab	Low
		Leiognathus brevirostris	Pony fish	Low
		Sparidae spp	Sea breams	Medium
0004	Discovery Bay	Mixed Species	Mixed Species	Low
		Portunus pelagicus	Blue crab	Low
		Argyrosomus spp	Croaker	Low
		Leiognathus brevirostris	Pony fish	Low
		Charybdis cruciata	Red crab	Low
0005	Tai Shui Hang	*Leiognathus brevirostris*	Pony fish	Low
		Charybdis cruciata	Red crab	Low
		Clupanodon punctatus	Gizzard shad	Low
		Portunus sanguinolentus	3-Spot crab	Low
		Metapenaeus affinis	Jinga shrimp	High
0022	Sham Shui Kok	Mixed Species	Mixed Species	Low
		Sebasticus marmoratus	Rockfish	Low
		Caranx kalla	Shrimp scad	Medium
		Argyrosomus spp	Croaker	Low
		Trichiurus haumela	Hairtail	Medium
0023	Yam O	Mixed Species	Mixed Species	Low
		Sebasticus marmoratus	Rockfish	Low

Code	Fishing Area	Top Five Fish Caught (by weight)		Commercial Value
		Species	Common Name	
		Clupanodon punctatus	Gizzard shad	Low
		Mugil affinis	Mullet	Low
		Sparidae spp	Sea breams	Medium
0024	Tsing Chau Tsai	Mixed Species	Mixed Species	Low
		Sebasticus marmoratus	Rockfish	Low
		Argyrosomus spp	Croaker	Low
		Muraenosox cinereus	Conger Pike Eel	Medium
		Sparidae spp	Sea breams	Medium
0025	Ma Wan	*Siganus oramin*	Rabbit fish	Low
		Sebasticus marmoratus	Rockfish	Low
		Mixed Species	Mixed Species	Low
		Argyrosomus spp	Croaker	Low
		Sparidae spp	Sea breams	Medium
0027	Peng Chau	Mixed Species	Mixed Species	Low
		Acetes spp	Silver shrimp	High
		Siganus oramin	Rabbit fish	Low
		Charybdis cruciata	Red crab	Low
		Johnius belengeri	Croaker	Low
0028	Kau Yi Chau	Mixed Species	Mixed Species	Low
		Acetes spp	Silver shrimp	High
		Siganus oramin	Rabbit fish	Low
		Argyrosomus spp	Croaker	Low
		Sardinella jussieu	Sardine	Low
0038	Tsing Lung Tau	Mixed Species	Mixed Species	Low
		Sebasticus marmoratus	Rockfish	Low
		Argyrosomus spp	Croaker	Low
		Siganus oramin	Rabbit fish	Low
		Acetes spp	Silver shrimp	High
0039	Tai Lam Chung	*Acetes* spp	Silver shrimp	High
		Muraenosox cinereus	Conger Pike Eel	Medium
		Mixed Species	Mixed Species	Low
		Sebasticus marmoratus	Rockfish	Low
		Argyrosomus spp	Croaker	Low

Note: Mixed Species consists of juveniles of *Carnax kalla, Siganus oramin, Sardinella* spp, *Leiognathus brevirostris* and *Clupanodon punctatus.*

2.2 *CULTURE FISHERIES*

The closest AFCD designated Fish Culture Zone (FCZ) to the Assessment Area is located at Ma Wan. Information from the AFCD indicates that, as at 31 Jan 2000, the Ma Wan FCZ consists of 132 licensed rafts from 82 licenses issued, with a total licensed area of 14,557 m^2 (total gazetted area = 46,300 m^2). There are no figures available for individual production at this FCZ, although the annual production of fish reared in Hong Kong has dropped from 2,960 tonnes in 1997 to 1,200 tonnes in 1998 as a result of a red tide outbreak. In March and April 1998, widespread red tide algal blooms caused fish kills at many of the FCZs in Hong Kong. However, the Ma Wan FCZ, due to the fast currents in the vicinity, was the least affected of the FCZs and only minimal fish kills occurred (AFCD *pers comm*). The main species cultured in Hong Kong were the spotted grouper (*Epinephelus chlorostigma*), gold-lined seabream (*Rhabdosargus sarba*), mangrove snapper (*Lutjanus argentimaculatus*) and the pompano (*Trachinotus blochii*).

2.3 *OTHER STUDIES*

Recent construction works for the Airport Core Programme projects, such as the North Lantau Development and North Lantau Highway, are likely to have caused disturbance to previously existing fisheries habitat in the area. These disturbances may have led to a reduction in the importance of the North Lantau coastline as a nursery area. The main commercial fisheries in the vicinity of North Lantau are shrimp trawling and purse seining for migratory croaker [6]. Fish species can move away from the temporarily affected areas, while the shrimp are very prolific, having remained in the area despite disturbance from recent marine construction works in the area. In addition, as the water quality is generally poor due to the influence of the waters of the western harbour area and SSDS Stage I outfall discharges [7], fisheries resources in the waters of eastern Lantau may have been adversely impacted.

All fish and macro-invertebrate species recorded in a trawl survey undertaken in the South Tsing Yi area as part of the EIA for Backfilling of South Tsing Yi and North Lantau [8] were commonly found in the coastal waters of Hong Kong. Their numbers and abundances were low.

Results of a 12-month fishery survey initiated in August 1995 around Penny's Bay[1] revealed that the fisheries resources in the area are generally in a poor state as indicated by the low numbers collected per unit of fishing effort, the extremely low encounter rate for large schools of the dominant pelagic fish, and the undersized nature of the catch. The cause of this poor state of the resource was attributed by the authors to a combination of overfishing and

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([6]) ERM-Hong Kong Ltd (1995) *op cit.*

([7]) Mouchel Asia Limited (1998) Strategic Sewage Disposal Scheme Stage 1 Baseline Monitoring and Performance Verification. First Annual Report for Environmental Protection Department, July 1998.

([8]) *Ibid.*

([1]) CES (Asia) Ltd (1997a) Lantau Port Development Stage 1 Fisheries Resources Survey. Final Report submitted to Civil Engineering Department, June 1997.

habitat degradation from pollution and disturbance (dredging and dumping).

In 1995 survey, the waters at Fa Peng, Penny's Bay, Discovery Bay and Peng Chau were considered to be important nursery areas for fish fry that are important to the local fry fishery[10]. Five taxa, collected in the survey, including four species of sparid and one taxon of salangid, were important to the local fry fishery.

However, the most recent and up to date data from the AFCD Fisheries Study [11] identified the most important fisheries spawning and nursery areas in Hong Kong waters (*Figure 9.2b* and *9.2c*). As can be seen from the figures the Penny's Bay area was not regarded as an important spawning or nursery area.

[10] CES (Asia) Ltd (1997b) Lantau Port Development: Stage 1 Fish Fry Survey. Final Report submitted to Civil Engineering Department, February 1997.

(11) ERM (1998) *Op cit.*

3.1 ICHTHYOPLANKTON SURVEYS

3.1.1 Methodology

As little is known about the commercial fishery spawning and nursery status of North Lantau waters, ichthyoplankton (fish eggs and larvae) sampling was included in the Study to assess the value of the North Lantau area as a nursery and spawning ground for commercial fisheries. Due to the seasonal nature of juveniles of commercial fish species, the trawling was conducted once in the wet season (September 1998) and once in the dry season (February 1999) for stations T1 - T6 to ensure that no species of importance were overlooked.

Ichthyoplankton trawls, using a Rigosha conical plankton mesh net (mesh size 80 μm, length 60 cm, mouth diameter 12 cm) were conducted in the Assessment Areas (for NSLDFS and the Theme Park and associated developments) to quantitatively assess the abundance of juveniles, eggs and larvae of commercial fisheries species. Four replicate 10 minute surface tows were conducted at each of the ten sites (T1 - T6 for NSLDFS EIA Study, T7 - T10 for Theme Park EIA Study) shown on *Figure 3.1a*. The ichthyoplankton samples were preserved in formalin for subsequent identification and enumeration[1].

To supplement the dry season ichthyoplankton information obtained for North Lantau, ichthyoplankton trawl surveys were also conducted in Penny's Bay in December 1999. Due to the seasonality in these resources, only the dry seasons survey results of the North Lantau ichthyoplankton trawls are compared with the findings of the Penny's Bay trawls. The results of both of these surveys are presented below.

3.1.2 Results

NSLDFS Trawl Stations (T1 - T6)

During the dry season surveys (conducted on 5 February 1999), ichthyoplankton samples were largely comprised of eggs of sardine *Sardinella nymphaea* and larvae of sea bream *Sparus latus* (*Table 3.1a*). Ichthyoplankton abundances were found to be higher in the trawl samples collected from stations T5 and T6.

[1] Taxonomic identification of samples was conducted by Prof ZR Chen of the South China Sea Institute of Oceanology, The Chinese Academy of Sciences, China.

Table 3.1a ***Composition of the Ichthyoplankton Trawls around Norhteast Lantau during the Dry Season (February 1999)***

Transect	Family	Species	Mean Abundance/10 min trawl
T1	Clupeidae	*Sardinella nymphaea*	2.0 eggs
T2	Clupeidae	*Sardinella nymphaea*	2.0 eggs
T3	Sparidae	*Sparus latus*	0.3 larva
T4	Clupeidae	*Sardinella nymphaea*	1.5 eggs
	Sparidae	*Sparus latus*	0.8 larva
T5	Clupeidae	*Sardinella nymphaea*	3.8 eggs
T6	Clupeidae	*Sardinella nymphaea*	3.8 eggs

The results of the NSLDFS survey indicated that the marine areas around the northeast Lantau area support low abundance of eggs and larvae of mainly low value commercial pelagic species.

Penny's Bay Trawl Stations (T7 - T10)

In the December (dry season) trawl surveys at Penny's Bay, eggs, prelarvae and larvae of a total of 8 species were identified (*Table 3.1b*). They include sardines *Sardinella nymphaea* and *S. jussieu*, rockfish *Sebasticus marmoratus*, sea bream *Sparus latus*, dragonnet *Callionymus richardsoni*, red pargo *Pagrosomus major*, mullet *Mugil cephalus* and *Harengula ovalis*.

The composition of the ichthyoplankton tows comprised mainly eggs of *Sardinella nymphaea, S. jussieu* and *Sparus latus* (*Table 3.1b*). Prelarvae of *Sardinella nymphaea, Sparus latus* and *Mugil cephalus*, and larvae of *Sebasticus marmoratus* were also identified in the samples. Two of the species identified, ie *Sparus latus* and *Pagrosomas major*, are of higher commercial value than the other species identified for the Penny's Bay samples.

Species were more diverse at trawl stations located in outer bay area (ie T9 and T10) where eggs of *Sardinella nymphaea, S. jussieu*, and *Sparus latus* were more abundant when compared to the samples collected from the inner bay stations (ie T7 and T8). In general, sampling stations located at outer Penny's Bay (T9 and T10) showed a higher species diversity (in terms of species number) and abundance of ichthyoplankton than those located in inner bay region.

Table 3.1b ***Composition of the Ichthyoplankton Trawls around Penny's Bay during the Dry Season (December 1999)***

Transect	Family	Species	Mean Abundance/10 min trawl
T7	Clupeidae	*Sardinella nymphaea*	0.3 egg; 0.5 prelarva
	Scorpaenide	*Sebastiscus marmoratus*	1.0 larva
	Sparidae	*Sparus latus*	0.3 egg; 0.3 prelarva
T8	Clupeidae	*Sardinella nymphaea*	1.0 egg
	Sparidae	*Sparus latus*	0.8 egg; 0.8 prelarva
T9	Clupeidae	*Sardinella nymphaea*	3.8 eggs; 0.8 prelarva
		Harengula ovalis	0.3 egg
	Scorpaenide	*Sebastiscus marmoratus*	0.5 larva
	Sparidae	*Sparus latus*	2.0 eggs; 1.5 prelarva
	Mugilidae	*Mugil cephalus*	0.3 prelarva
	Callionymidae	*Callionymus richardsoni*	0.3 egg
T10	Clupeidae	*Sardinella nymphaea*	2.8 eggs; 0.5 prelarva
		Sardinella jussieu	5.8 eggs; 2.3 prelarva
	Scorpaenide	*Sebastiscus marmoratus*	1.0 larva
	Sparidae	*Sparus latus*	5.0 eggs; 1.8 prelarva
		Pagrosomas major	0.3 egg
	Mugilidae	*Mugil cephalus*	0.5 prelarva
	Callionymidae	*Callionymus richardsoni*	0.5 prelarva

The dry season ichthyoplankton trawl results obtained from Penny's Bay in December 1999 were compared to the data recorded in February 1999 for North Lantau and in March 1998 for Little Green Island, Green Island and Hong Kong Island (*Table 3.1c*). The plankton tows from Penny's Bay contained the highest mean abundance of eggs, prelarvae and larvae than the other four sites. The number of species recorded was also highest at Penny's Bay. However, it should be noted that none of the areas listed below in *Table 3.1c* support commercial fish fry operations and were not identified in the Fisheries Resources and Fishing Operations in Hong Kong Waters Study as being important fish fry or spawning grounds. Although fish fry can be found in Penny's Bay and the other locations presented in *Table 3.1c* the abundance is low and insufficient to support the commercial operation of fry fisheries.

Table 3.1c ***Mean Abundance (10 minute trawl^{-1}) of eggs, prelarvae and larvae of the Ichthyoplankton Trawls Obtained during the Dry Season around North Lantau, Penny's Bay, Little Green Island, Green Island and Hong Kong Island***

Site	No of Species	Mean Abundance/10 min trawl		
		Eggs	Prelarva	Larva
North Lantau	2	2.1	0.0	0.2
Penny's Bay	8	5.8	2.3	0.6
Little Green Island*	7	3.3	0.1	0.4

Site	No of Species	Mean Abundance/10 min trawl		
		Eggs	Prelarva	Larva
Green Island*	3	1.1	0.8	0.1
Hong Kong Island*	3	0.9	0.0	0.0

*: Ichthyoplankton data from the ongoing Green Island Development - Studies on EWQIA and MITA for TDD of the HKSAR.

3.2 *SUMMARY*

While Penny's Bay showed the highest abundance of ichthyoplankton when compared to the results obtained for Little Green Island, Green Island and Hong Kong Island, the majority of the species identified are of low commercial value. It should be noted that none of the areas listed above support commercial fish fry operations and were not identified in the Fisheries Resources and Fishing Operations in Hong Kong Waters Study as being important fish fry or spawning grounds. Although fish fry can be found in Penny's Bay and the other locations detailed above, the abundance is low and insufficient to support the commercial operation of fry fisheries. Based on the results obtained from surveys and a review of relevant literature, the waters of Penny's Bay do not appear to be an important nursery and spawning ground for commercial fisheries resources.

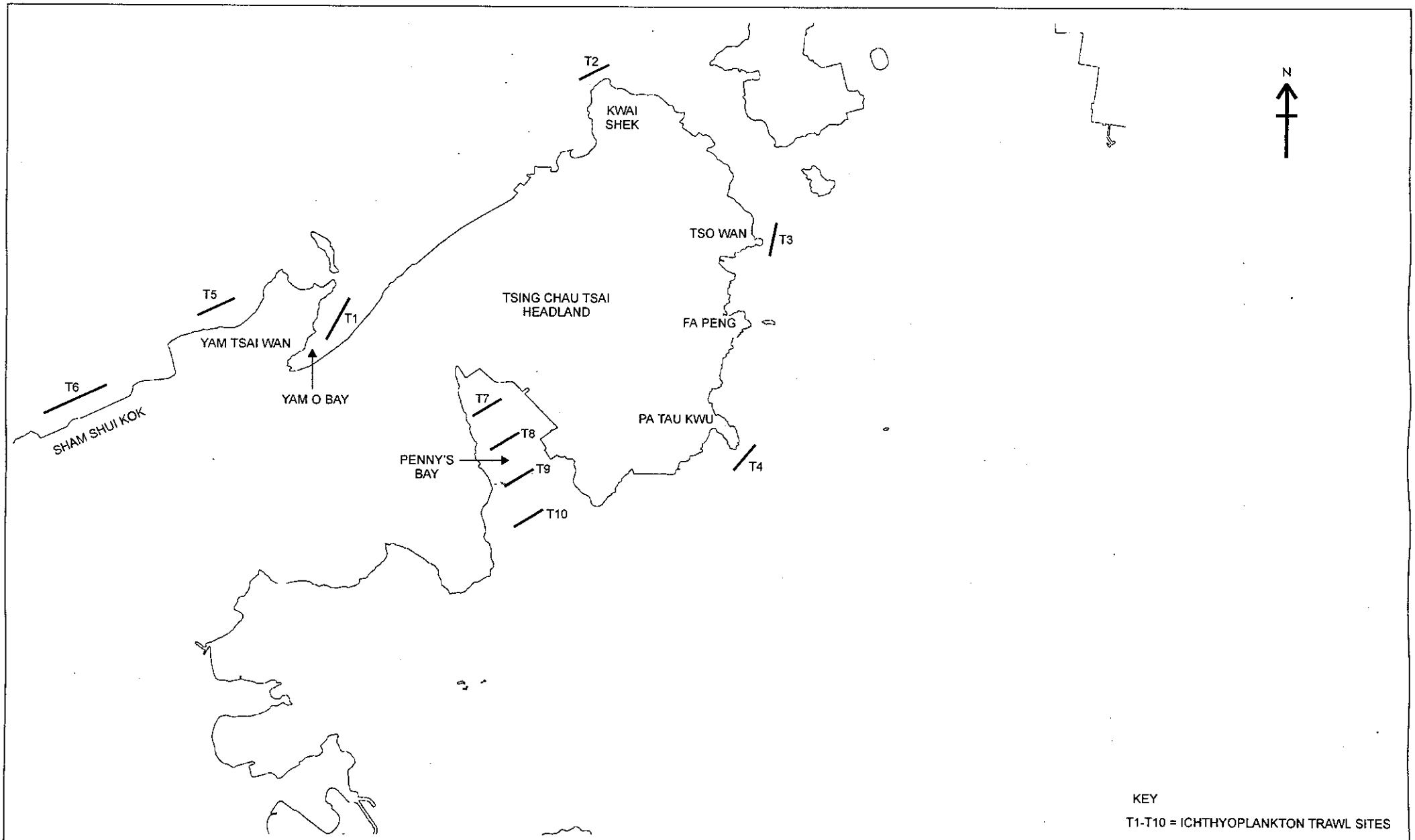

FIGURE 3.1a

ICHTHYOPLANKTON TRAWL SITES ON NORTH LANTAU

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