

AEC Limited

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Coral Survey Report
for
Upgrading of Tai Po Sewage Treatment Works -
Investigation

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1. SUMMARY

The aim of present survey was to obtain ecological baseline of the coral communities along the coastline of Tai Po Waterfront Park under the project 'Ecological Survey for Upgrading of Tai Po Sewage Treatment Works - Investigation'. Spot-Check Dive Survey and Rapid Ecological Assessment (REA) were conducted along the modified shoreline of Tai Po Waterfront Park in October 2020.

The sub-tidal environment of survey route was an artificial shoreline consisted of mainly large boulders. The survey route was nearly devoid of coral. Only one small colony of zebra coral *Oulastrea crispate* was found at the eastern survey route. This coral species was a widely distributed species with high tolerance to water turbidity. Both international and local protections were not applicable for this coral species. However the shoreline supported abundant biofouling fauna and fish community. The ecological value of the coral community was categorized as 'Low'.

For other species of conservation importance, two individuals of spotted seahorse *Hippocampus kuda* were found. In order to avoid and reduce any developmental impacts on the seahorses, proper mitigation measures should be adopted especially adjacent to the REA transect T1.

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2. INTRODUCTION

The aim of present survey was to obtain ecological baseline of the coral communities along the coastline of Tai Po Waterfront Park under the project 'Ecological Survey for Upgrading of Tai Po Sewage Treatment Works - Investigation'.

3. METHODOLOGIES

3.1 Spot-Check Dive Survey

A spot-dive reconnaissance check was conducted along a ~1.8 km modified shoreline of Tai Po Waterfront Park (Fig. 3.1) on 18th October 2020 under sunny weather. The survey route covered the existing emergency outfall of Tai Po Sewage Treatment Works. A zig-zag dive route was conducted along the shoreline focusing on subtidal hard substratum (e.g. boulder blocks seawall and vertical seawall) (Fig. 3.2) and muddy sea floor at water depth 1.0-2.0 m. It aimed to check and locate any presence of coral communities, including hard corals (order Scleractinia), octocorals (sub-class Octocorallia) and black corals (order Antipatharia). For locations of high (or relatively higher) coral coverage, the shore locations were recorded with a Global Positioning System (GPS) device (model: GARMIN 78s). Representative photographs of corals were taken.

The water visibility was unsatisfactory (< 1 m) due to high water turbidity at the western side of coastline. It was due to the sediment runoff from Lam Tsuen River. The vision of dive surveyors was limited while any corals of farer distance (e.g. > 1 m from the dive surveyor), if present, might be omitted easily. At the eastern side of coastline, the water visibility was



relatively better (3-4 m).

3.2 Rapid Ecological Assessment (REA)

Since coral was found during the spot-check dives, one shore location with coral was chosen for detailed Rapid Ecological Assessment (REA) with reference to DeVantier *et al.* (1998) (Appendix II). The REA survey was conducted on 24th October 2020 under cloudy weather while the water visibility was fair (3-4 m). At the REA location (T1), a 100 m transect line was laid along the subtidal hard substratum at 1.5-2.0 m water depth. During the REA survey, detailed information of corals was recorded including number of colonies, type, size, relative coverage, health condition and translocation feasibility. After the REA survey, it was to assess the conservation status of the recorded coral species in Hong Kong waters.



Eastern coastline



Middle coastline



Western coastline



Figure 3.1 Photographic record of the environment of the survey areas

Drawing No. 2 - Tentative Marine Ecological Survey Plan

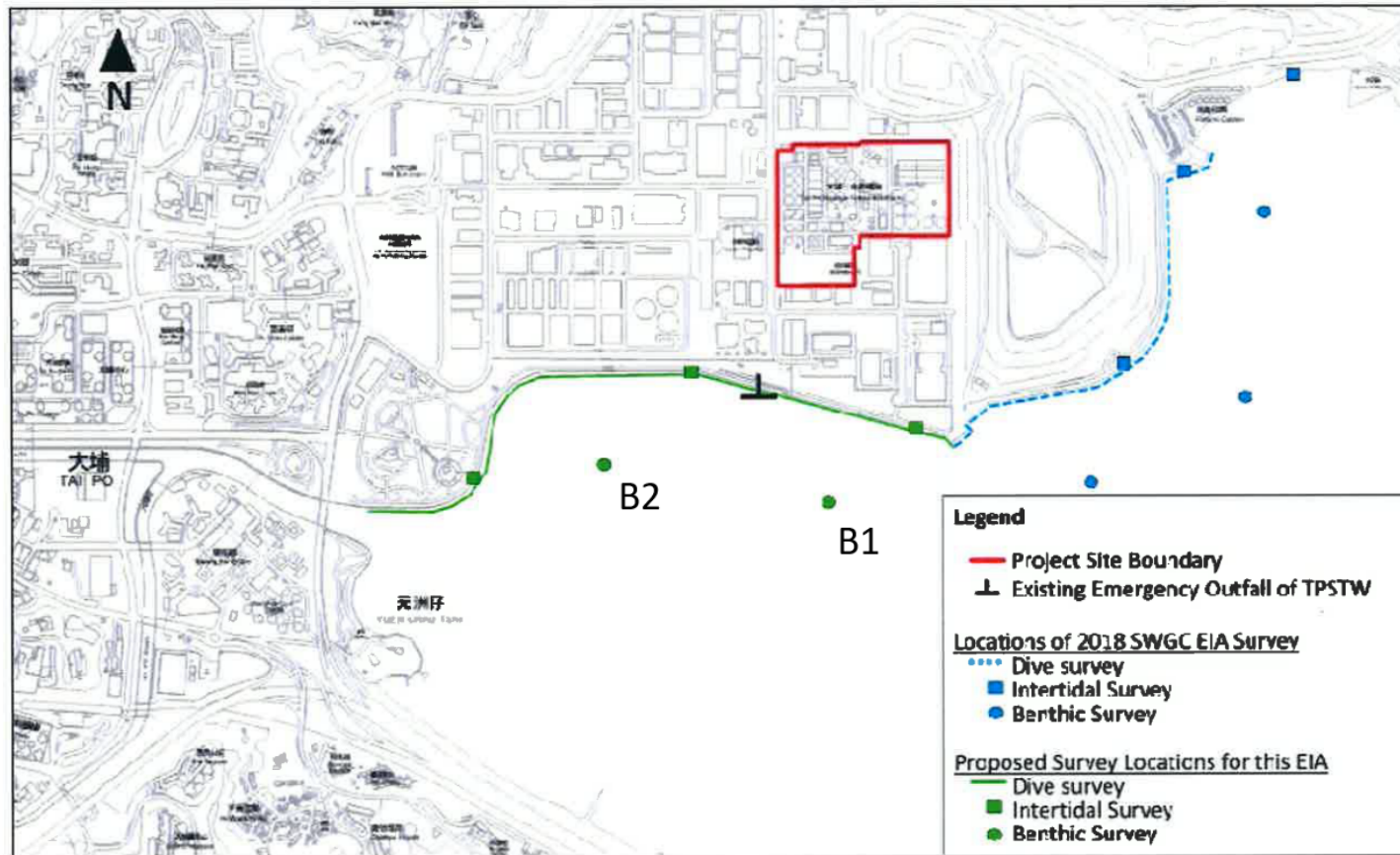


Figure 3.2 Survey route of spot-check dive (green line) for coral communities (map from tender document of Drainage Services Department, HKSAR Government)



Table 3.1 The length and GPS coordinates (start-point and end-point) of the REA transect T1

WGS84 datum (ITRF96 Reference Frame)					
Transect	Length (m)	Start-point		End-point	
		Latitude (N)	Longitude (E)	Latitude (N)	Longitude (E)
T1	100	N 22° 27.073'	E 114° 11.491'	N 22° 27.087'	E 114° 11.434'

Drawing No. 2 - Tentative Marine Ecological Survey Plan

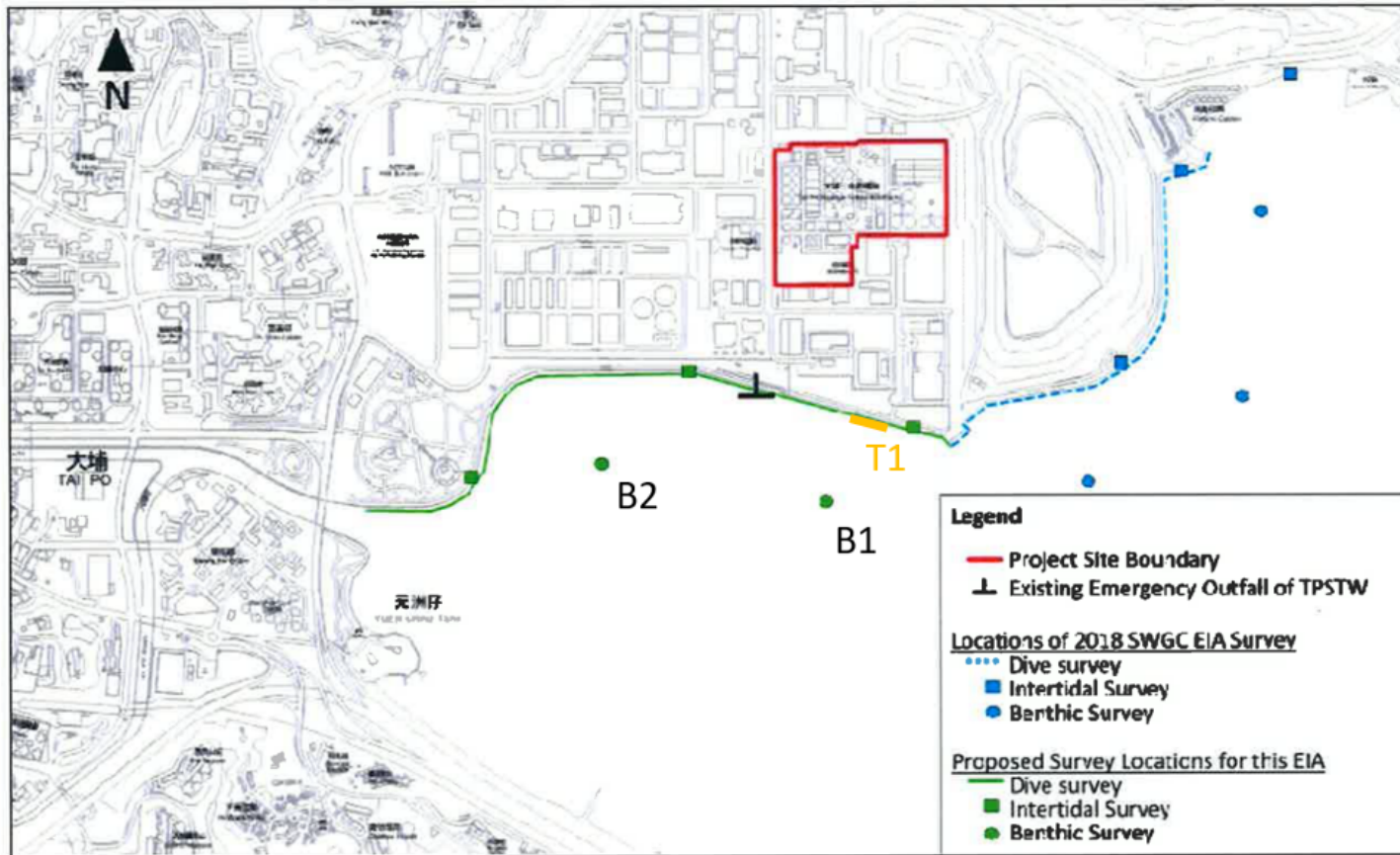


Figure 3.3 Transect survey location (T1, yellow line) of REA (map from tender document of Drainage Services Department, HKSAR Government)

4. RESULTS

4.1 Spot-check Dive Survey

Along the whole survey route, the water depth ranged 1.5-2.0 m at the eastern end and was shallower (~1.0 m) at the western end. Starting from the east, the sub-tidal environment was a short section of vertical seawall (length ~50 m) while the rest of shoreline was large boulder blocks (diameter > 50 cm, length ~1750 m) (Fig. 4.1). Both the seawall surface and boulder blocks were colonized with biofouling fauna such as barnacle *Megabalanus tintinnabulum*, green lipped mussel *Perna viridis*, rock oyster *Saccostrea cucullata* and tunicate *Styela plicata* (Fig. 4.2). Other motile fauna such as crabs and gastropods were found inhabiting between the boulders. The adjacent sea floor was soft mud covered with broken shells detached from the hard surface. Large garbage (e.g. dumped bicycle) with biofouling organisms was found occasionally on sea floor (Fig. 4.3).

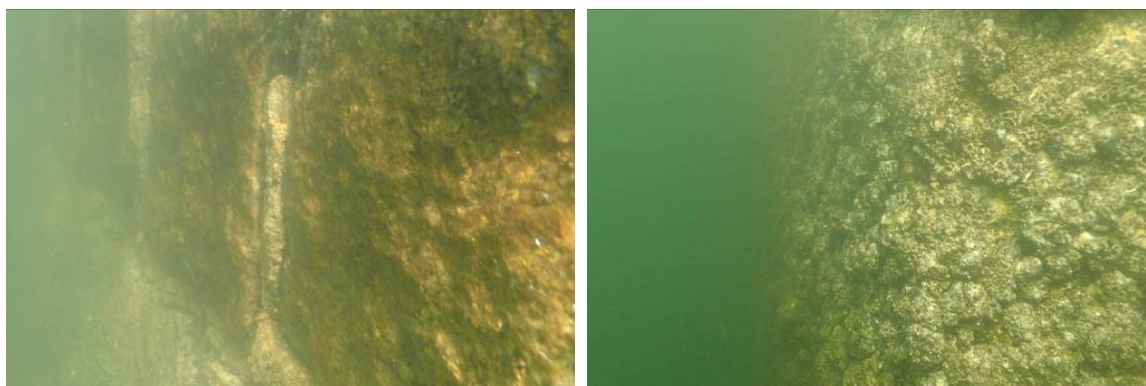
Zebra coral *Oulastrea crispata* was found at one location along the whole survey route. Detailed information was provided in the following REA results section.

Besides, a fish community of moderate species richness and high abundance was found along the shoreline composed of large boulder blocks. The common and abundant fish species were spotted scat *Scatophagus argus*, banded goby *Amblygobius phalaena*, blenny *Omobranchus fasciolatoceps* and planiliza mullet *Planiliza* spp. (Fig. 4.4).

4.2 Rapid Ecological Assessment (REA)

Along the whole REA transect T1, the substratum was all large boulders (diameter > 50 cm) (100%) with adjacent soft mud seafloor. As mentioned, the boulders were colonized by biofouling organisms such as barnacle, mussel and rock oysters. Table 4.1 list the REA ecological attribute and coral taxa of the T1. There was one small colony of zebra coral *Oulastrea crispata* (Fig. 4.5) recorded only that contributed less than 1% cover of the transect (rank 0.5). Its abundance was ranked '1 Rare'. The colony width was about 5 cm in healthy condition. The exact location of the zebra coral was at the start-point of T1 (GPS coordinate N 22° 27.073' E 114° 11.491').

In addition, two individuals of spotted seahorse *Hippocampus kuda* (Fig. 4.5) were found at the middle of REA transect (50-55 m). No other seahorse was recorded in the rest of the survey route.



Vertical seawall (~50 m)



Large boulder blocks (~1750 m)



Soft mud seafloor covered with broken shells

Figure 4.1 Photographic record of sub-tidal environment along the survey route



barnacle *Megabalanus tintinnabulum*



green lipped mussel *Perna viridis*



rock oyster *Saccostrea cucullata*



tunicate *Styela plicata*

Figure 4.2 Photographic record of common biofouling fauna on the hard surface along the survey route

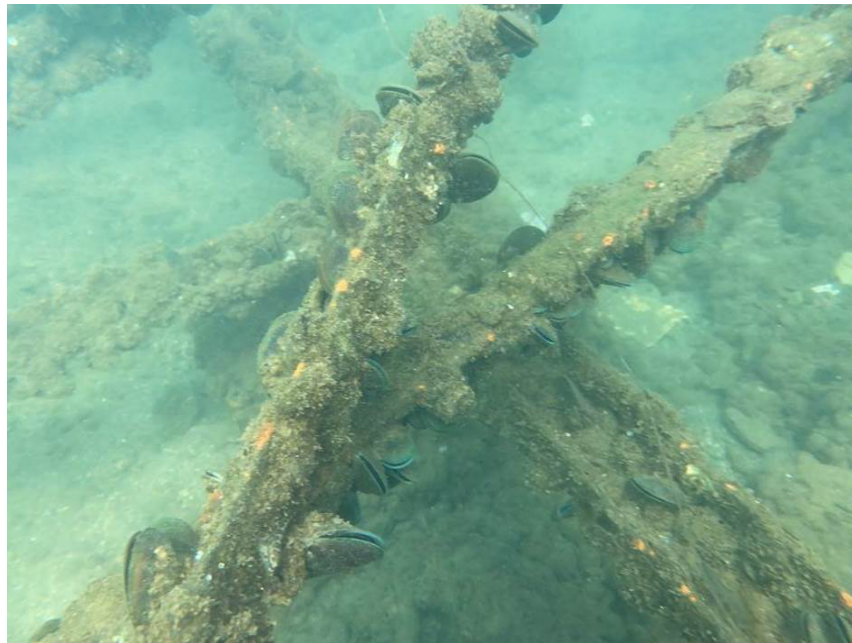


Figure 4.3 Photographic record of large garbage along the survey route



Spotted scat *Scatophagus argus*



Banded goby *Amblygobius phalaena*



Blenny *Omobranchus fasciolatoceps*

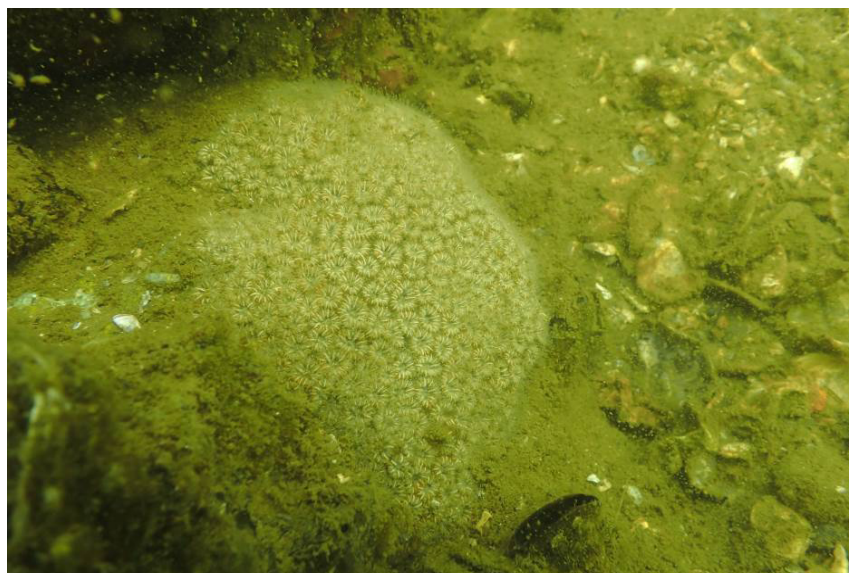


Planiliza mullet *Planiliza* spp.

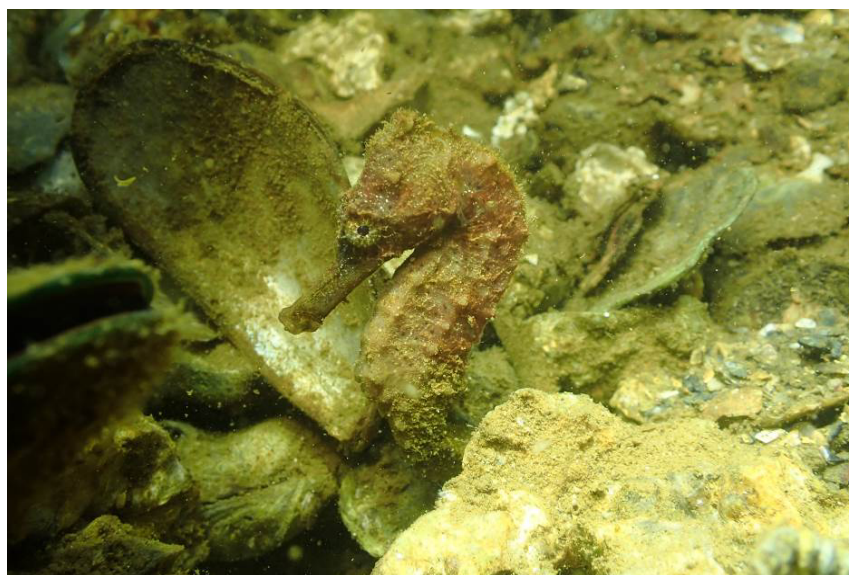
Figure 4.4 Photographic record of common and abundant fish species along the survey route

Table 4.1 REA ecological attribute and coral taxa of the REA transect T1

Transect	Ecological attribute	Rank	Percentage cover	Genus / Species	No. of colony	Size (w: width, h: height)	Taxon abundance rank	Abundance	Health condition
T1	Hard Corals	0.5	< 1	<i>Oulastrea crispata</i>	1	d: 5 cm	1	Rare	Healthy



Zebra coral *Oulastrea crispata*



Spotted seahorse *Hippocampus kuda*

Figure 4.5 Photographic record of zebra coral *Oulastrea crispata* and spotted seahorse *Hippocampus kuda* found along the REA transect T1

5. DISCUSSION

5.1 Environmental condition

The present survey area locates within the Tolo Harbour and Channel Water Control Zone (WCZ). The Tolo Harbour and Channel WCZ (especially the Harbor Subzone nearby Sha Tin and Tai Po) had been severely polluted and plagued with red tides in 1980s due to discharges of untreated sewage and livestock waste (EPD, 2006). Since the implementation of Tolo Harbour Action Plan in 1986 had contained the sewage and livestock problems, steady recovery of water quality was observed. There were clear decreasing trends of 5-days Biochemical Oxygen Demand (BOD₅), *E. coli* and total inorganic nitrogen, ammonia nitrogen and orthophosphate from 1986 to 2018 (details see EPD, 2019). However the overall compliance rate of water quality objective (WQO) was not satisfactory (57-79%) in the past few years (2014-2018) (details see EPD, 2019). The reason was the persistent low compliance of dissolved oxygen (DO) objective at various water quality monitoring stations (e.g. TM6, TM7 and TM8). The heavily landlocked situation and narrow exit to the open sea in Tolo Harbour led to weak tidal flushing and water circulation (EPD, 2006). Thermal stratification could be easily formed particularly during summer. Hence low oxygen condition was naturally resulted in bottom water.

In present coral survey, the sub-tidal environment along survey route was very shallow. The dissolved oxygen would be at sufficient level due to effective surface aeration. It accounted for abundant biofouling fauna and a fish community at moderate abundance. The effect of stormwater pollution was stronger (i.e. high turbidity) at the western side of the survey route due to the runoff from Lam Tsuen River. It was based on lower abundances of fish and fouling fauna at the western side of survey route. According to a previous benthic survey

conducted nearby the present survey shoreline under the same project, the sediment condition was low in oxygen level. The sediments were grey or even black in colour with smell of hydrogen sulphite. It indicated mild to moderate organic loading in the sediments. The landlocked shape of harbour might have facilitated the occurrence of thermal stratification in deeper area.

5.2 Conservation and ecological status of coral community

Table 5.1 lists the conservation status, local distribution and stress tolerance of the coral taxa and other species of conservation importance recorded in the present survey. Zebra coral *Oulastrea crispata* is categorized as 'Least Concern - LC' in IUCN Red List of Threatened Species. The international conservation status is low according to the Red List criteria. It distributes widely in Hong Kong waters and is reported to have high tolerance to water turbidity (AFCD, 2016).

Zebra coral *Oulastrea crispata* is listed in 'Appendix II' of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). There is certain level of protection from illegal collection via licensing controls on international trade.

In Hong Kong, corals in Marine Parks and Marine Reserve are protected under Marine Park Ordinance. And certain types of corals listed in Schedule 1 and 2 of the Protection of Endangered Species of Animals and Plants Ordinance receive protection through legislative control on import, export and possession of corals. However the zebra coral in the present survey does not fall into these two situations. Local protection by legislation is not applicable.

Along the survey route, the coral community was characterized of very low species number (1



hard coral species) and abundance (< 1 percentage cover along the REA transect) on large boulder blocks. The zebra coral recorded was stress tolerant species. In general the sub-tidal environment was nearly devoid of coral along the survey route.

Besides coral, there was another species of conservation importance, spotted seahorse (or yellow seahorse) *Hippocampus kuda* found along the REA transect T1. It is categorized as ‘Vulnerable - VU’ in IUCN Red List of Threatened Species. The wild populations are considered to be facing a high risk of extinction in the wild. Moreover it is listed in ‘Appendix II’ of CITES while the international trade and procession are under control. In Hong Kong, the local populations face the threat of overfishing for traditional medicine and aquarium as well as trawling by-catch.

Spotted seahorse *Hippocampus kuda* distributed mainly in the eastern waters of Hong Kong such as Hoi Ha Wan, Tai Mei Tuk within Tolo Harbour, Tap Mun, Port Island, Kat O, Kau Sai and Sharp Island. Their local populations were defined as ‘moderately abundant’ in Hong Kong waters (AFCD, 2012). This species had been reported high tolerance to variable salinity (15-33 ppt) (Hilomen-Garcia *et al.*, 2003). Their occurrence was reasonable in the present survey area near the downstream of Lam Tsuen River in Tolo Harbour. However there is no documentation about its tolerance to water turbidity.

5.3 Ecological value of the survey area

Table 5.2 lists the criteria for evaluating the coral communities of the present survey route according to EPD (1997). The sub-tidal environment of survey route was an artificial shoreline consisted of mainly large boulders. The survey route was nearly devoid of coral.

Only one small colony of zebra coral *Oulastrea crispate* was found at the eastern survey route. This coral species was a widely distributed species with high tolerance to water turbidity. Both international and local protections were not applicable for this coral species. However the shoreline supported abundant biofouling fauna and fish community. The ecological value of the coral community was categorized as 'Low'.

For other species of conservation importance, two individuals of spotted seahorse *Hippocampus kuda* were found. In order to avoid and reduce any developmental impacts on the seahorses, proper mitigation measures should be adopted especially adjacent to the REA transect T1.



Table 5.1 Conservation status, local distribution and stress tolerance of the coral taxa and other species of conservation importance recorded

Coral taxa	Conservation status	Local distribution	Stress tolerance
Hard coral			
<i>Oulastrea crispata</i>	IUCN Red List: Least Concern CITES: Appendix II	Widely distributed in HK waters	High to water turbidity
Spotted seahorse			
<i>Hippocampus kuda</i>	IUCN Red List: Vulnerable CITES: Appendix II	Eastern waters of Hong Kong such as Hoi Ha Wan and Tai Mei Tuk within Tolo Harbour, Tap Mun, Port Island, Kat O, Kau Sai and Sharp Island.	High to variable salinity; No documentation about turbidity tolerance


Table 5.2 Criteria for evaluating the coral communities of the survey area

Criteria	Remarks
Naturalness	Artificial shoreline consisted of mainly large boulders
Size	N.A.
Diversity	Very low species number (1 species)
Rarity	Spotted seahorse <i>Hippocampus kuda</i> in very low abundance (two individuals)
Re-creatability	High
Fragmentation	N.A.
Ecological linkage	N.A.
Potential value	N.A.
Nursery/breeding ground	N.A.
Age	N.A.
Abundance/Richness of wildlife	Very low abundance of corals (1 small colony) High abundance of biofouling fauna and fish community
Ecological value	Low

N.A.: Non-applicable



6. REFERENCES

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Appendix I Rapid Ecological Assessment

Rapid ecological assessment (details see DeVantier *et al.*, 1998) is a two-tiered approach for underwater survey to assess the sub-littoral substrata and benthic organisms. This methodology has been modified to suit Hong Kong conditions and has become a standardised and widely adopted way to establish ecological baseline conditions. Two levels of information are to be recorded in a swathe ~2 m wide, 1 m on either side of each transect:

Tier I will assess the relative cover of major benthic groups and substrata

Tier II will provide an inventory of sedentary / sessile benthic taxa, which are also ranked in terms of their abundance in the community at the survey site.

Self-evidently, data have to be recorded by an expert who is experienced in field identification of sedentary / sessile benthic taxa, particularly corals.

Tier I: Categorization of benthic cover

For each transect, ecological and substratum attributes should be categorized and ranked. The required attributes are detailed in the table below:

Table of Tier I Benthic Attribute Categories

Ecological Attributes	Substratum Attributes
Hard Corals	<u>Hard substrata</u>
Octocorals (soft corals and gorgonians)	Bedrock / continuous pavement
Black corals	Boulder blocks (diam. > 50 cm)
Dead Standing Corals	Boulder blocks (diam. < 50 cm)
	Rubble
	Other
	<u>Soft substrata</u>
	Sand
	Mud / Silt

Table of Tier I Ordinal Ranks of Percentage Cover of Benthic Attributes

Rank*	Percentage Cover
0	None recorded
0.5	1-5%
1	6-10%
2	11-30%
3	31-50%
4	51-75%
5	76-100%

* Note: For substratum attributes, it is preferable to record actual estimates of cover. The percentage of hard substrata vs soft substrata can be provided (e.g. 80% and 20% respectively). The percentage cover of the types of hard or soft substrata could also then be presented (e.g. bedrock pavement 60%, rubble 20%, sand 15%, mud/silt 5%). Similarly, recording and presenting actual estimates of , for instance, hard and soft coral cover may be more informative (e.g. < 1%) and is also an approach adopted by similar recent survey reports.

Tier II: Taxonomic inventories to define types of benthic communities

An inventory of benthic taxa along each transect should be compiled during the survey. The taxa should be defined in situ to at least the following levels:

Table of Tier II Taxonomic Inventory Identification

For each transect, each taxon in the inventory should be ranked in terms of abundance in the community.

Type of Benthos	Level of Taxa
Hard corals	Species level, wherever possible
Octocorals	Genus level
Black Corals	Genus level



Table of Tier II Ordinal Ranks of Taxon Abundance

Taxon Abundance Rank	Abundance
0	Absent
1	Rare
2	Uncommon
3	Common
4	Abundant
5	Dominant

The taxon categories should be ranked in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks are visual assessments of abundance, rather than quantitative counts of each taxon. Representative photos of organisms should be taken.

Appendix II Taxonomic resolution of every recorded coral taxa

Kingdom	Phylum	Class	Order	Family	Species
Animalia	Cnidaria	Anthozoa	Scleractinia	Oulastreidae	<i>Oulastrea crispata</i>

- End of Report -