T6.38 Macrobenthos density (ind./m^2) and diversity (H') at the study area (S1-S20) (cont'd)

Taxa	Station																			
	Foreshore Area																			
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Phylum: Annelida (cont'd)																				
Fam. Phyllodocidae																				
Phyllodoce sp.	-	-	-	-	-	-	-	-	10	-	-	-	10	-	-	-	10	-	-	-
Fam. Polynoidae																				
Iphione muncata	-	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-	20	-	-	-
Fam. Spionidae																				
Prionospio multibranchiata	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-
Prionospio cornuta	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-
Prionospio ehlersi	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-
Prionospio malayensis	-	-	-	-	20	-	-	-	-	-	-	-	10	-	-	10	20	-	-	-
Subtotal (ind./m^2)	**10**	**240**	**70**	**0**	**20**	**20**	**0**	**60**	**10**	**50**	**0**	**40**	**220**	**10**	**0**	**20**	**350**	**10**	**0**	**20**
Phylum: Mollusca																				
Class: Gastropoda																				
Natica sp.	20	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nucula sp.	-	-	-	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phos sp.	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Class: Bivalvia																				
Anadara granosa	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trachycardium sp.	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified bivalve spats	-	50	-	-	10	50	70	20	-	-	10	20	30	30	20	20	-	-	20	-
Subtotal (ind./m^2)	**130**	**50**	**0**	**120**	**10**	**60**	**70**	**20**	**0**	**0**	**10**	**20**	**30**	**30**	**20**	**20**	**0**	**0**	**20**	**0**
Phylum: Arthropoda (Crustacea)																				
Alpheidea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphipoda																				
Gammaridea	-	-	-	-	-	10	20	-	30	-	-	-	60	10	-	-	-	-	-	-
Hyperiidea	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anomura	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	10	-
Brachyura																				
Porcellanidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caridea	-	30	-	-	10	-	-	-	-	-	-	-	10	-	-	-	10	0	10	10
Cumacea	-	-	30	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-
Isopoda	-	-	-	-	10	-	-	-	-	-	-	-	10	-	20	-	-	20	-	-
Penaeidea	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Thalassinoidea	-	-	-	-	10	-	10	-	-	-	-	-	30	-	-	-	-	-	-	-
Subtotal (ind./m^2)	**0**	**50**	**30**	**0**	**30**	**30**	**40**	**0**	**30**	**0**	**10**	**0**	**110**	**10**	**30**	**0**	**10**	**20**	**20**	**10**
Phylum: Echinodermata																				
Class Ophiuroidea																				
Ophionereis reticulata	-	60	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-
Ophiothrix sp.	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Class Holothuroidea	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal (ind./m^2)	**0**	**90**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10**
Density (ind./m^2)	**140**	**430**	**100**	**120**	**60**	**110**	**110**	**80**	**50**	**50**	**20**	**60**	**360**	**50**	**50**	**40**	**360**	**30**	**40**	**40**
Diversity Index (H')	**1.12**	**2.53**	**1.51**	**0.00**	**1.56**	**1.41**	**1.03**	**1.49**	**0.95**	**1.33**	**0.69**	**1.56**	**2.43**	**0.95**	**1.06**	**1.04**	**2.68**	**0.64**	**1.04**	**1.04**

T6.39 Macrobenthos density (ind./m^2) and diversity (H') at the study area (S21-S42)

Taxa	Station																					
	Foreshore Area																					
	S21	S22	S23	S24	S25	S26	S27	S28	S29	S30	S31	S32	S33	S34	S35	S36	S37	S38	S39	S40	S41	S42
Phylum: Annelida																						
Class: Polychaeta																						
Fam. Ampharetidae																						
Auchenoplax crinita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Amphinomidae																						
Chloeia violacea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Capitellidae																						
Heteromastus similis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mediomastus warrenae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Notomastus aberans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	-	-	-	-
Mediomastus capensis	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Notomastus latericeus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	10	-	-	-	-
Fam. Eunicidae																						
Eunice indica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-
Eunice sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Glyceridae																						
Glycera alba	-	-	-	-	10	-	-	-	20	-	-	-	-	10	-	10	-	-	-	-	-	-
Glycera tesselata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glycera prashadi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Hesionidae																						
Leocrates indicus	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Lumbrineridae																						
Lumbrineris latreilli	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	-	10	-	-	-	-
Lumbrineris albidentata	-	-	-	-	-	-	-	-	10	-	-	-	-	10	-	-	-	-	-	-	-	-
Fam. Maldanidae																						
Axiothella sp.	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Euclymene sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Nephtyidae																						
Aglaophamus orientalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	10
Aglaophamus dibranchus	-	-	-	-	-	-	-	20	40	-	-	-	30	-	-	10	-	-	-	-	-	-
Micronephtys sphaerocirrata	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Nereididae																						
Ceratocephale fauveli	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-
Ceratonereis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-
Gymnonereis fauveli	-	-	-	-	-	-	10	10	-	-	-	-	-	-	-	-	10	-	-	-	-	-
Fam. Onuphidae																						
Onuphis eremita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Orbiniidae																						
Scoloplos (Leodamas) gracilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scoloplos (Leodamas) rubra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Haploscoloplos elongatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fam. Paraonidae																						
Aricidea (Acmira) simplex	-	-	-	-	-	-	10	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-
Paradoneis armata	-	-	-	-	-	-	10	-	20	-	-	-	-	20	-	-	-	-	-	-	-	-
Aricidea (Acmira) sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

T6.39 Macrobenthos density (ind./m^2) and diversity (H') at the study area (S21-S42) (cont'd)

Taxa	Station																					
	Reclamation Area (Within Reclamation Footprint)																Offshore Area (Outside Reclamation Footprint)					
	S21	S22	S23	S24	S25	S26	S27	S28	S29	S30	S31	S32	S33	S34	S35	S36	S37	S38	S39	S40	S41	S42
Phylum: Annelida (cont'd)																						
Fam. Phyllodocidae																						
Phyllodoce sp.	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	10	-	-	-
Fam. Polynoidae																						
Iphione muncata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-
Fam. Spionidae																						
Prionospio multibranchiata	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Prionospio cornuta	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Prionospio ehlersi	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-
Prionospio malayensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal (ind./m^2)	**0**	**0**	**0**	**0**	**10**	**0**	**40**	**50**	**180**	**0**	**0**	**0**	**30**	**40**	**0**	**40**	**20**	**60**	**20**	**0**	**0**	**10**
Phylum: Mollusca																						
Class: Gastropoda																						
Natica sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-
Nucula sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	-
Phos sp.	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Class: Bivalvia																						
Anadara granosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trachycardium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified bivalve spats	120	20	20	70	80	50	30	-	-	20	20	20	30	50	20	-	10	30	80	50	70	110
Subtotal (ind./m^2)	**120**	**20**	**20**	**70**	**80**	**50**	**40**	**0**	**0**	**20**	**20**	**20**	**30**	**50**	**20**	**0**	**10**	**40**	**80**	**60**	**80**	**10**
Phylum: Arthropoda (Crustacea)																						
Alpheidea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-
Amphipoda																						
Gammaridea	-	-	-	-	-	-	30	30	110	-	-	-	-	-	-	-	-	40	-	-	-	10
Hyperiidea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anomura	-	-	10	-	-	10	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	10
Brachyura																						
Porcellanidae	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-
Caridea	-	-	-	-	20	-	-	-	30	-	-	-	20	-	-	-	-	20	-	-	-	10
Cumacea	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	10	-	10	-	-	-
Isopoda	-	-	-	30	20	-	-	10	10	-	10	-	30	-	-	-	-	-	-	30	20	-
Penaeidea	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	10	10	-	-	-
Stomatopoda	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Thalassinoidea	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal (ind./m^2)	**0**	**0**	**10**	**30**	**40**	**10**	**30**	**40**	**210**	**0**	**40**	**0**	**50**	**0**	**0**	**0**	**10**	**80**	**20**	**30**	**20**	**30**
Phylum: Echinodermata																						
Class Ophiuroidea																						
Ophionereis reticulata	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-
Ophiothrix sp.	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-
Class Holothuroidea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
Subtotal (ind./m^2)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**70**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Density (ind./m^2)	**120**	**20**	**30**	**100**	**130**	**60**	**110**	**90**	**460**	**20**	**60**	**20**	**110**	**90**	**30**	**40**	**30**	**80**	**140**	**10**	**30**	**130**
Diversity Index (H')	**0.00**	**0.00**	**0.64**	**0.61**	**1.07**	**0.45**	**1.80**	**1.68**	**2.64**	**0.00**	**1.33**	**0.00**	**1.37**	**1.15**	**0.64**	**1.39**	**1.39**	**2.32**	**1.10**	**0.94**	**0.80**	**0.95**

T6.40 Macrobenthos density (ind./m^2) and diversity (H') at the study area (S43-S49)

Taxa	Station						
	Off Pulau Kendi			Off Pulau Rimau			
	S43	S44	S45	S46	S47	S48	S49
Phylum: Annelida							
Class: Polychaeta							
Fam. Ampharetidae							
Auchenoplax crinita	-	-	-	-	-	-	-
Fam. Amphinomidae							
Chloeia violacea	-	-	-	-	-	10	-
Fam. Capitellidae							
Heteromastus similis	-	-	-	-	-	-	-
Mediomastus warrenae	-	-	-	-	-	-	-
Notomastus aberans	-	-	-	-	-	-	-
Mediomastus capensis	-	-	-	-	-	-	-
Notomastus latericeus	-	-	-	-	-	-	-
Fam. Eunicidae							
Eunice indica	-	-	-	-	-	-	-
Eunice sp.	-	-	-	-	-	-	-
Fam. Glyceridae							
Glycera alba	20	-	-	-	-	-	-
Glycera tesselata	-	-	-	-	-	-	-
Glycera prashadi	-	-	-	-	-	-	-
Fam. Hesionidae							
Leocrates indicus	-	-	-	-	-	-	-
Fam. Lumbrineridae							
Lumbrineris latreilli	-	-	-	-	30	-	-
Lumbrineris albidentata	-	-	-	-	-	-	-
Fam. Maldanidae							
Axiothella sp.	-	-	-	-	-	-	-
Euclymene sp.	-	-	-	-	-	-	-
Fam. Nephtyidae							
Aglaophamus orientalis	-	-	-	-	20	-	-
Aglaophamus dibranchus	30	-	-	-	40	-	-
Micronephtys sphaerocirrata	10	-	-	-	-	-	-
Fam. Nereididae							
Ceratocephale fauveli	-	-	-	-	30	-	-
Ceratonereis sp.	-	-	-	-	-	-	-
Gymnonereis fauveli	-	-	-	-	20	-	-
Fam. Onuphidae							
Onuphis eremita	-	-	-	-	-	-	-
Fam. Orbiniidae							
Scoloplos (Leodamas) gracilis	10	-	-	-	-	-	-
Scoloplos (Leodamas) rubra	-	-	-	-	-	-	-
Haploscoloplos elongatus	-	-	-	-	20	-	-
Fam. Paraonidae							
Aricidea (Acmira) simplex	-	-	-	-	-	-	-
Paradoneis armata	-	-	-	-	20	-	-
Aricidea (Acmira) sp.	-	10	-	-	10	-	-

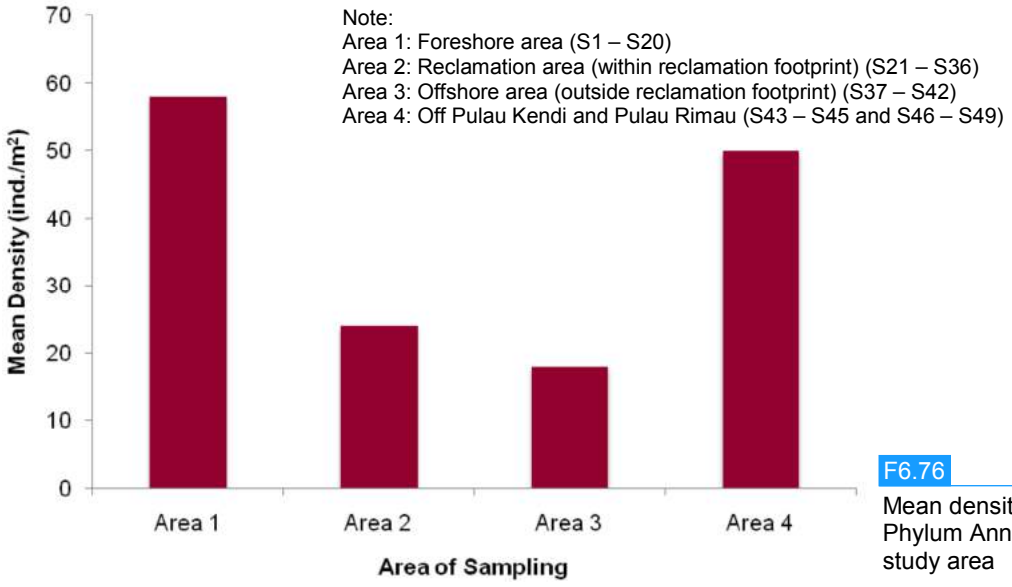
T6.40 Macrobenthos density (ind./m^2) and diversity (H') at the study area (S43-S49) (cont'd)

Taxa	Station						
	Off Pulau Kendi			Off Pulau Rimau			
	S43	S44	S45	S46	S47	S48	S49
Phylum: Annelida (cont'd)							
Fam. Phyllodocidae							
Phyllodoce sp.	-	-	-	-	-	-	-
Fam. Polynoidae							
Iphione muncata	-	10	-	-	20	-	-
Fam. Spionidae							
Prionospio multibranchiata	-	-	-	-	-	-	-
Prionospio cornuta	-	-	-	-	-	-	-
Prionospio ehlersi	-	-	-	-	10	-	-
Prionospio malayensis	-	-	-	-	30	-	-
Subtotal (ind./m^2)	**70**	**20**	**0**	**0**	**250**	**10**	**0**
Phylum: Mollusca							
Class: Gastropoda							
Natica sp.	-	-	-	-	-	-	-
Nucula sp.	-	-	-	-	-	-	-
Phos sp.	-	-	-	-	-	-	-
Class: Bivalvia							
Anadara granosa	-	-	-	-	-	-	-
Trachycardium sp.	-	-	-	-	-	-	-
Unidentified bivalve spats	0	30	20	70	20	-	30
Subtotal (ind./m^2)	**0**	**30**	**20**	**70**	**20**	**0**	**30**
Phylum: Arthropoda (Crustacea)							
Alpheidea	-	-	-	-	-	-	-
Amphipoda							
Gammaridea	-	-	30	-	180	-	-
Hyperiidea	-	-	-	-	-	-	-
Anomura	10	-	-	-	-	-	-
Brachyura							
Porcellanidae	-	-	-	-	-	-	-
Caridea	-	10	-	-	-	-	-
Cumacea	-	-	-	-	-	10	10
Isopoda	-	-	-	-	-	-	-
Penaeidea	-	-	-	-	-	-	-
Stomatopoda	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-
Thalassinoidea	-	-	-	-	-	-	-
Subtotal (ind./m^2)	**10**	**10**	**30**	**0**	**180**	**10**	**10**
Phylum: Echinodermata							
Class Ophiuroidea							
Ophionereis reticulata	-	-	-	-	-	-	-
Ophiothrix sp.	-	-	-	-	-	-	-
Class Holothuroidea	-	-	-	-	-	-	-
Subtotal (ind./m^2)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Density (ind./m^2)	**80**	**60**	**50**	**70**	**450**	**20**	**40**
Diversity Index (H')	**1.49**	**1.24**	**0.67**	**0.00**	**2.12**	**0.69**	**0.56**

The most abundant phylum was Annelida, which was represented by 16 families and 36 species. The mean density recorded was at 42±76 (0-350) ind./m^2. The most dominant family was the Nephtyidae, which comprised about 21.5% of the total polychaete density, followed by Glyceridae (15.5%), Nereididae (13.5%) and Spionidae (10.5%), while the others comprised less than 10%. In term of species, *Aglaophamus dibranchus* and *Glycera alba* were found to be the most abundant species, constituting 13.5 and 13.0% of the total density of annelids respectively. The mean density recorded at 6±12 (0-40) ind./m^2 for *A. dibranchus*, while 6±15 (0-80) ind./m^2 for *G. alba.*

A predominance of polychaete worms is a normal phenomenon for coastal benthic organisms in Malaysian waters (Sasekumar *et al.,* 1984). According to Day (1981), these annelids can be found at all depths of the marine ecosystem. In addition, they are known to have a high tolerance to organic pollution and natural perturbation (Ahsen *et al*., 2006; Bryan and Gibbs, 1987; Rygg, 1985). Polychaete worms usually act as the representative group in the assessment of the health of aquatic ecosystem. Most polychaetes have short life cycle and high reproduction rates, which enable them to show quick response on any changes in the environment such as the input of pollutants or organic material. Polychaete larvae may be capable of long distance transport, while the adults are relatively inert (Dean, 2008).

On the whole, the highest mean density of annelids was recorded at the foreshore area [58±97 (0-350) ind./m^2], followed by off Pulau Kendi/Pulau Rimau [50±92 (0-250) ind./m^2], area within the reclamation footprint (24±46 (0-180) ind./m^2) and area offshore area (outside the reclamation footprint) [18±22 (0-60) ind./m^2] (F6.76). A previous study by Sabine (2001) reported high density and diversity of polychaetes commonly observed in the mudflat sites.



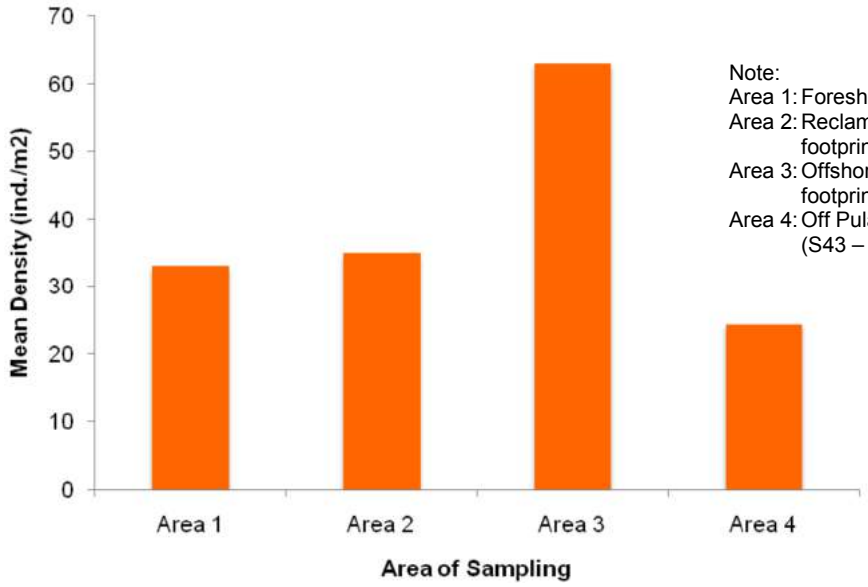
F6.76

Mean density (ind./m^2) of Phylum Annelida at the study area

Phylum Mollusca was represented by three taxa under Class Gastropoda and three taxa under Class Bivalvia. Gastropods and bivalves are known as the main group of molluscs found in the Malaysian waters (Wong and Arshad, 2011). However, their feeding habits are different, where gastropods are primarily algae scrapers or predators on sessile animals, while a bivalve are filter or detritus feeders. The mean density was recorded at 35±35 (0-130) ind./m^2.

The high density was mostly contributed by unidentified bivalve spats that cover 82.6% of the total Mollusca count. The mean density of bivalve spats was 29±30 (0-120) ind./m^2. Bivalve spat is the stage where they begin to lose the larval organs such as velum, foot or eyespot, and form the adult structures. A new shell is also laid down by the mantle during this time (FAO, 1990).

On the whole, the highest mean density of molluscs was recorded offshore area (outside of the reclamation footprint) [63±35 (10-110) ind./m^2], followed by within the reclamation footprint [35±33 (0-120) ind./m^2], foreshore area [33±38 (0-130) ind./m^2] and off Pulau Kendi/ Pulau Rimau [24±24 (0-70) ind./m^2] (F6.77). This finding coincided with the zooplankton assessment, where the highest mean density of molluscs larvae was recorded at the offshore area (outside of the reclamation footprint) [1.35±2.05 (0-3.71) ind./L], while the lowest was recorded off Pulau Kendi/Pulau Rimau [0.09±0.12 (0-0.18) ind./L].

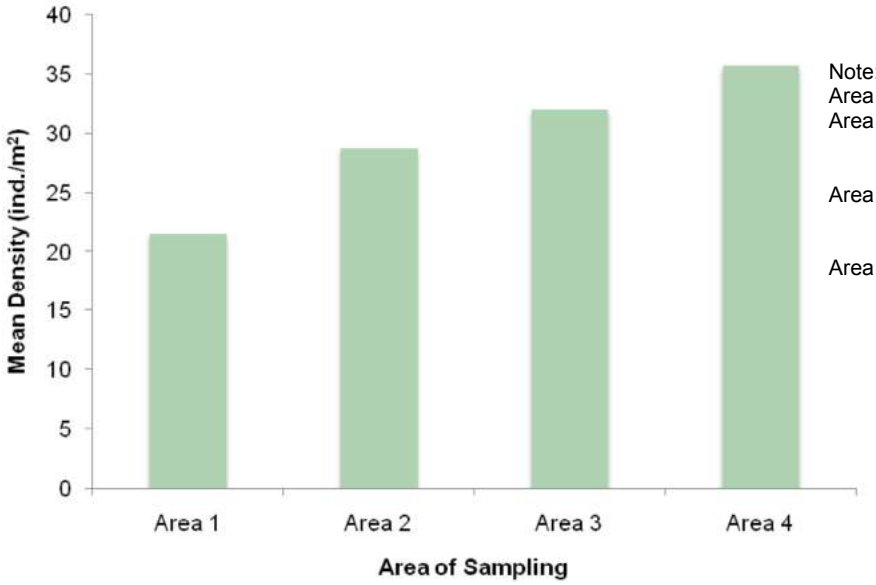


F6.77

Mean density (ind./m^2) of Phylum Mollusca at the study area

Arthropoda (Crustacea) was the third most abundant phylum, with mean density of 27±41 (0-210) ind./m^2. This phylum consisted of several orders, of which Amphipoda was the most abundant, accounting for 42.9% of the total crustacean count. Amphipods act as an important link between producers and higher consumers such as fish in the food webs. Amphipods also have proven difficult to identify due to their small size and morphology. However, they are usually used as bioindicator of pollution since they are sensitive to environmental conditions (Zaabar *et al*., 2015). On the whole, the highest mean density of arthropods recorded was off Pulau Kendi/Pulau Rimau [36±64 (0-180) ind./m^2], followed by the offshore area (outside the reclamation footprint) [32±25 (10-80) ind./m^2], area within the reclamation footprint [29±52 (0-210) ind./m^2] and foreshore area (22±26 (0-110) ind./m^2) (F6.78).

The high density in Pulau Kendi/Pulau Rimau could be related to the lower pollution loads off the island. Foreshore areas receiving daily inputs from land-based pollutant flows is probably the main reason for the low density of arthropods recorded during the current study. In addition, a previous study by Thomas (1993) reported amphipods to be dominant macrobenthic crustaceans inhabiting available substratum (microhabitat) in coral reef ecosystems (Thomas, 1993). This coincides with the findings of the current study which recorded amphipod as the most abundant group in Pulau Kendi/Pulau Rimau.

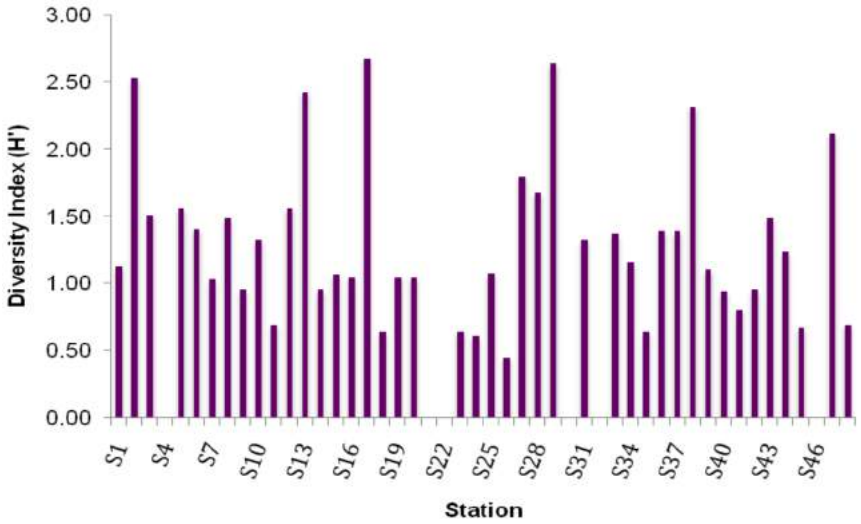


Note:
Area 1: Foreshore area (S1 – S20)
Area 2: Reclamation area (within reclamation footprint) (S21 – S36)
Area 3: Offshore area (outside reclamation footprint) (S37 – S42)
Area 4: Off Pulau Kendi and Pulau Rimau (S43 – S45 and S46 – S49)

F6.78
Mean density (ind./m^2) of Phylum Anthropoda at the study area

The least abundant phylum was Echinodermata, which consisted of two groups. Class Ophiuroidea was found to be more dominant, covering 89.5% of the total density of Echinoderms, while the remaining 10.5% was constituted by Class Holothuroidea. Echinodermata was only recorded at the foreshore area and the area within the reclamation footprint with mean density of 6±20 (0-90) ind./m^2 and 5±18 (0-70) ind./m^2 respectively.

Overall, the mean macrobenthos density at the study area was 107±112 (20-460) ind./m^2. The mean Shannon Weiner Diversity Index (H') recorded at 1.12±0.69 (0-2.68), where most of the stations showed a moderate diversity pattern (F6.79). The highest value was recorded at S17 (foreshore area) (2.68), followed by S29 (within reclamation footprint) (2.64), S2 (foreshore area) (2.53) and S13 (foreshore area) (2.43).



F6.79
Macrobenthos diversity index (H') at the study area

6.3.2.1.3 Coral Reefs

Coral reef assessment was carried out at Pulau Kendi and Pulau Rimau. The survey was conducted from 12th to 15th April 2016. A total of eight dive sites were involved, with four sites each at Pulau Kendi and Pulau Rimau. The diving duration at each site ranged from 45 to 60 minutes. The weather during the dive survey was sunny. Sea conditions were characterised by moderate currents and high turbidity. Hence, poor visibility conditions prevailed. The location and description of each dive site are provided in T6.41 and F6.80.

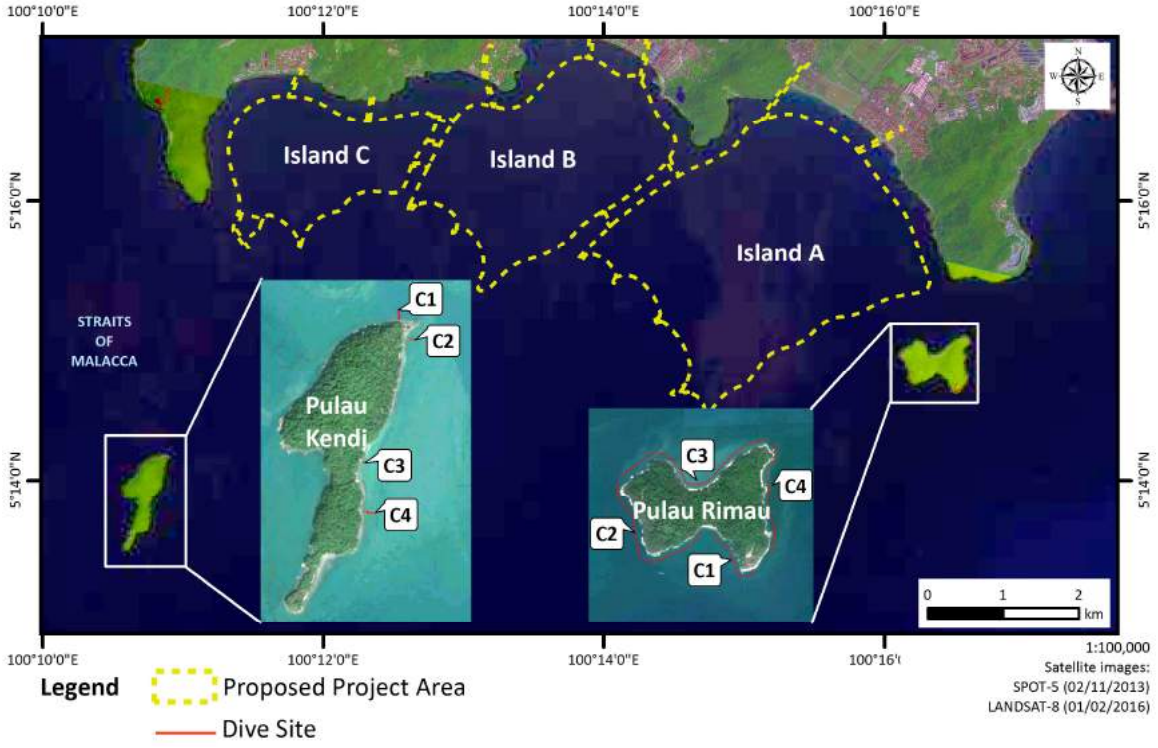
a) Methodology

Two different methods were carried out for the coral assessment, which are:

i) at Pulau Kendi - Line Intercept Transect (LIT) method with minor modification was employed. Cells were arranged in parallel rows, stretching from the coastline to the outermost seaward limit of the coral boundary; and
ii) at Pulau Rimau - The survey method had to be modified because the LIT method was not applicable. This was due to vertical distribution of coral reefs on slopes, rocks and boulders of the island. Dive survey had to be undertaken along the perimeter of the island.

T6.41 Description of the dive sites for coral reef assessment

Transect	Coordinates		Description					
	Start	End	Date	Time	Weather	Line (m)	Depth (m)	Visibility (m)
Pulau Kendi (LIT Method)								
C1	05°14.175'N 100°10.874'E	05°14.197'N 100°10.085'E	12/4/16	0910	Sunny	30	10.7	0.6
C2	05°14.130'N 100°10.899'E	05°14.127'N 100°10.911'E		1048		20	4.5	1.8
C3	05°13.847'N 100°10.776'E	05°13.842'N 100°10.787'E		1200		20	3.7	1.8
C4	05°13.730'N 100°10.772'E	05°13.723'N 100°10.805'E		1330		60	3.0	3.0
Pulau Rimau (Perimeter Transect)								
C5	05°14.618'N 100°16.549'E	05°14.746'N 100°16.419'E	15/4/16	0900	Sunny	400	4.0	2.7
C6	05°14.755'N 100°16.378'E	05°14.916'N 100°16.951'E		1300		900	4.1	2.7
C7	05°14.928'N 100°16.126'E	05°15.035'N 100°16.597'E	13/4/16	0900		1,000	4.0	0.3
C8	05°15.025'N 100°16.608'E	05°14.671'N 100°16.590'E	14/4/16	0900		700	2.6	0.6



F6.80 Locations of the dive sites at the study area

The general procedure employed at each site was as follows:

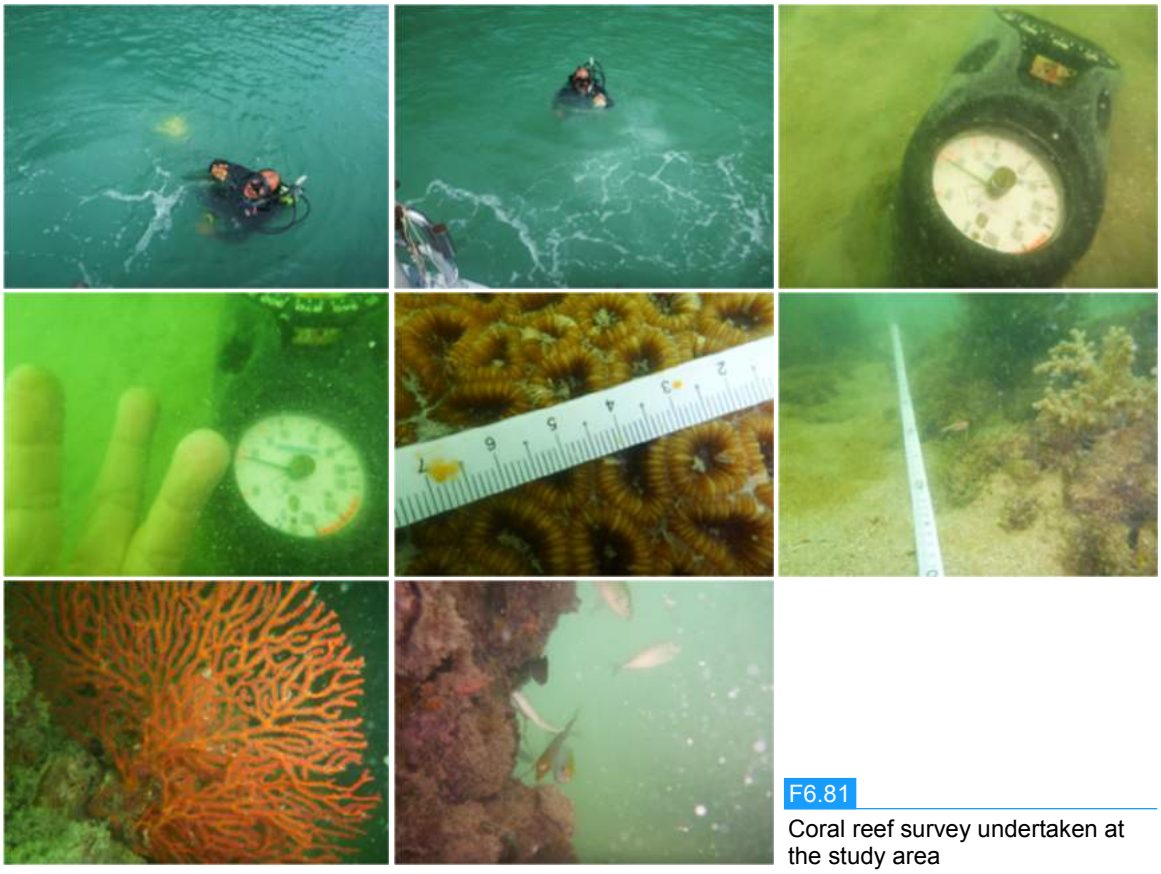
i) *Line Intercept Transect* (LIT) - The positions of each line were established and respective positions were plotted by GPS. Once these positions were established, a team of divers laid transect lines (C1 to C4) from the coastline to the coral edge (further offshore), approximately 20 to 60 m long (depending on the coral area) using a measuring tape (F6.81). Then, the divers left the survey area for 10 minutes to allow normal fish activity to resume. The divers then returned and recorded species of coral/ fish/other organisms on the polyester data sheet along the transect line and 5 m wide x 5 m high corridor.

ii) *Perimeter Transect* - The position of each point was plotted using GPS. A team of divers dived vertically along the four (C5 to C8) perimeter transects covering a distance of 400 to 1,000 m for each transect along the coastline. Along the perimeter transect, divers recorded species of coral/fish/other organisms on the polyester data sheet.

iii) The coral species were identified up to genera/species level where possible in the field or after the dive were completed using field guidebooks. Among the references that provided background material for the identification of species, but not limited to, were Kelley (2009), Veron (2000), Janes and Lee (2007), Fabricius and Alderslade (2001), Allen and Steen (1999), van Ofwegen *et al.* (2000), Tullock (1997), Delbeek and Sprung (1994), Chou (1988), van Ofwegen (1987), Millis (1985) and Searle (1980).

iv) The data collected includes approximate locations, speciation (including reef fish and invertebrates), distribution, percentage coverage and health of coral reef.

v) Photographs and short videos were also taken.



F6.81
Coral reef survey undertaken at the study area

b) Results

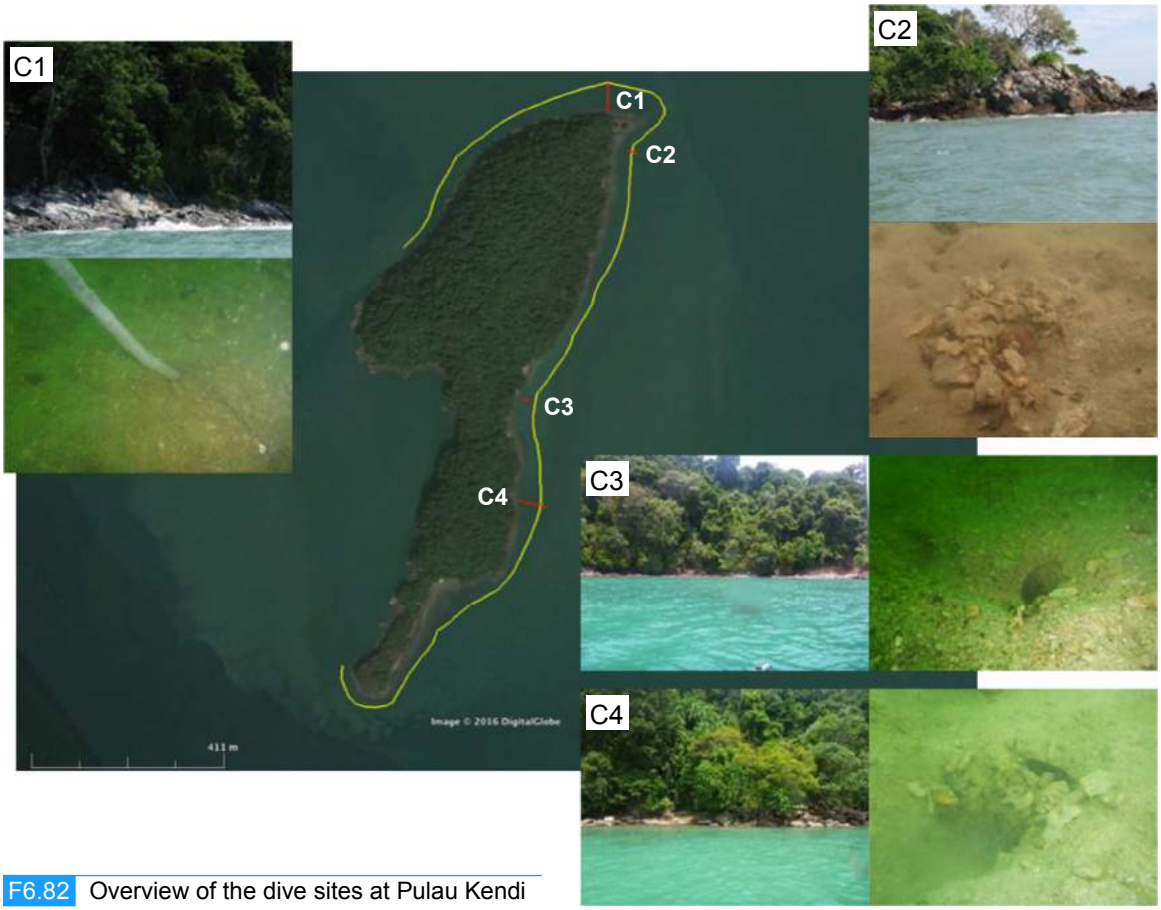
■ Coral Species Identification

Coral reefs are among the most diverse and valuable ecosystems on earth. They provide economic and environmental services worth about $375 billion each year to millions of people as shoreline protection, areas of natural beauty, recreation and tourism, sources of food, pharmaceuticals as well as revenues (Wilson et al., 2005; Costanza *et al.*, 1997). In addition, they form nurseries and breeding grounds for an estimated 25% of all marine animals as well as home to one-third of all fish species found worldwide (Reef Check Malaysia, 2008).

Within the study site, coral reefs are found in the vicinity of Pulau Rimau and Pulau Kendi, and surveyed as part of this investigation. The coral reef surveys at Pulau Kendi (C1 to C4) and Pulau Rimau (C5 to C8) were undertaken in April 2016, the outcomes of which appear below.

i) Pulau Kendi

Pulau Kendi is an island with natural rock formations. The hills on the island are very steep and densely forested (F6.83). There is only one stretch of sandy beach (C3), though it is very small. Based on the diving survey, the bottom sediment type was generally of muddy sand (F6.82).



F6.82 Overview of the dive sites at Pulau Kendi

Pulau Kendi had a higher number of hard corals, possibly due to the better water quality, being offshore of Pulau Rimau. 13 genera of hard corals (eight families) were recorded (T6.42); with some genera such as Star Coral (*Favites* sp.), Sun Coral (*Turbinaria* sp.), Anemone Coral (*Goniopora* sp.) as well as Boulder Coral (*Porites* sp.) in higher abundance as compared to other genera (F6.83). Five genera of gorgonians from four families were recorded in Pulau Kendi, with the Sea Fan (Echinogorgia sp.) being the most widespread taxa recorded (F6.84). Only two genera of soft corals were recorded in Pulau Kendi i.e. Leather coral (*Sinularia* sp.) and Magnificent Sea Anemone (*Heteractis magnifica*).

T6.42 Coral species recorded at Pulau Kendi

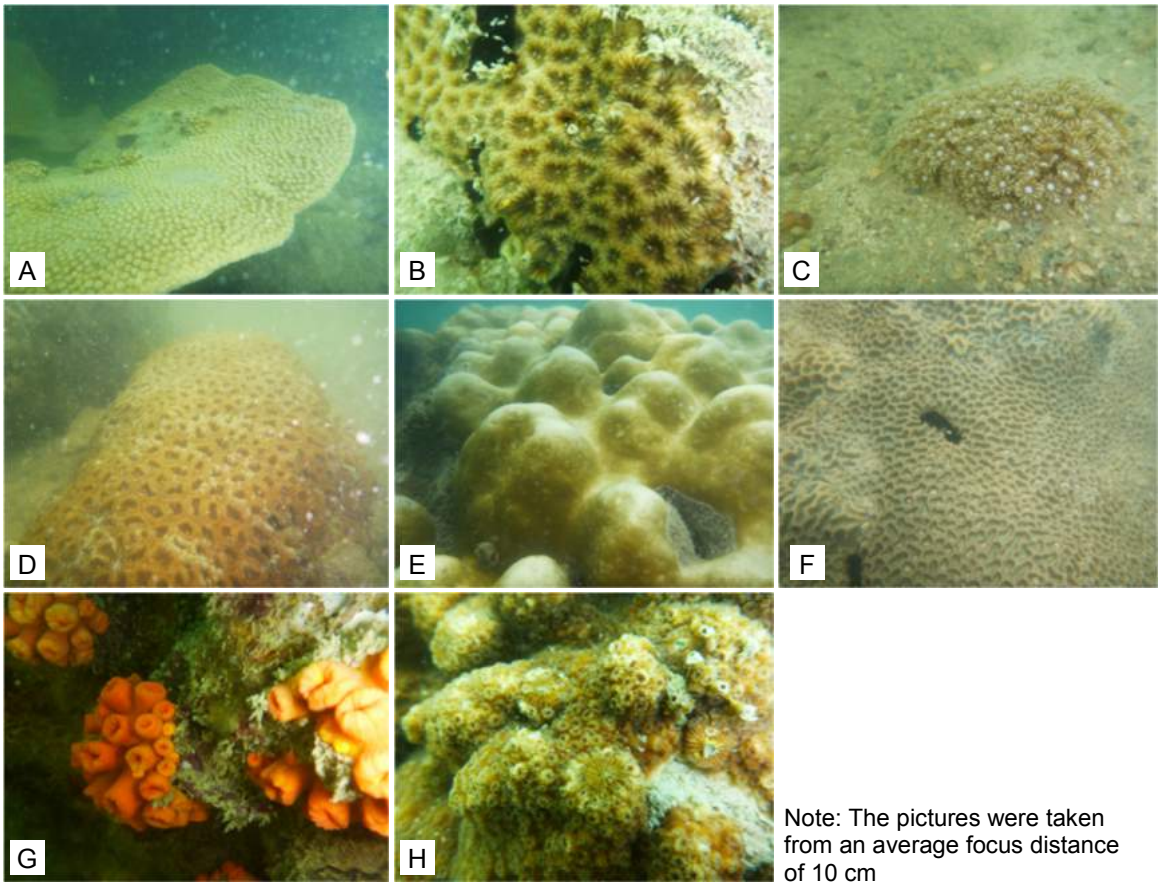
Type	Family	Species	Common Name	Station			
				C1	C2	C3	C4
Gorgonians	Ellisellidae	*Subergorgia* sp.	Sea Fan	+	+		
	Gorgoniidae	*Guaiagorgia* sp.	Sea Fan	+	+		
	Melithaeidae	*Melithaea* sp.	Sea Fan	+			
	Plexauridae	*Echinogorgia* sp.	Sea Fan	+	+	+	
		Menella sp.	Sea Fan	+	+		
Soft Coral	Alycyoniidae	*Sinularia* sp.	Leather Coral		+		
	Stichodactylidae	*Heteractis magnifica*	Magnificent Sea Anemone		+		

Note: '+' – present

T6.42 Coral species recorded at Pulau Kendi (cont'd)

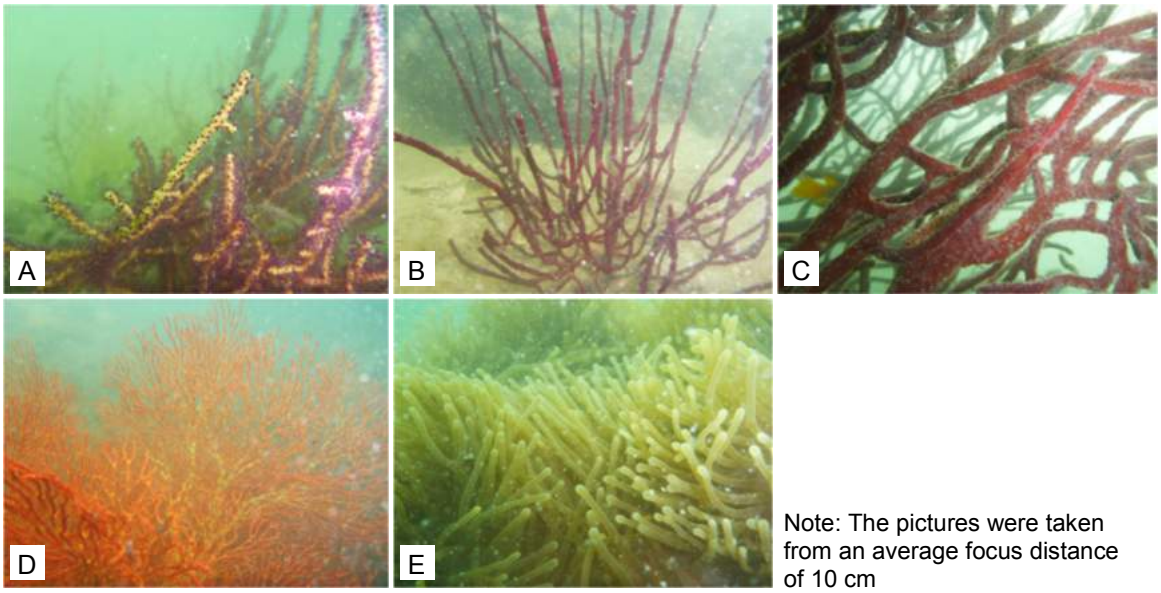
Type	Family	Species	Common Name	Station			
				C1	C2	C3	C4
Hard Coral	Agariciidae	*Pachyseris speciosa*	Elephant Skin Coral			+	
	Antipathidae	*Cirrhipathes* sp.	Wire Coral	+	+	+	
	Caryophylliidae	*Caryophyllia* sp.	Cup Coral	+	+	+	
	Dendrophyllidae	*Tubastrea* sp.	Sun Coral		+	+	+
		Turbinaria sp.	Table Coral	+	+	+	+
	Faviidae	*Diploastrea heliopora*	Moon Coral	+	+	+	
		Favia sp.	Moon Coral		+	+	+
		Favites sp.	Star Coral	+	+	+	+
		Monstastrea sp.	Pineapple Coral	+		+	+
	Merulinidae	*Goniastrea* sp.	Lesser Star Coral			+	
	Mussidae	*Symphyllia* sp.	Brain Coral			+	
	Poritidae	*Goniopora* sp.	Anemone Coral	+	+	+	+
		Porites sp.	Boulder Coral	+	+	+	+

Note: '+' – present



Note: The pictures were taken from an average focus distance of 10 cm

F6.83 Scleractinian coral found at Pulau Kendi. A: Table Coral (*Turbinaria sp.*), B: Lesser Star Coral (*Goniastrea sp.),* C: Anemone Coral (*Goniopora sp.*), D: Moon Coral (*Favia sp.*), E: Boulder Coral (*Porites sp.*), F: Star Coral (*Favites sp.*), G: Sun Coral (*Tubastrea sp.*), H: Pineapple Coral (*Montastrea sp.*)



Note: The pictures were taken from an average focus distance of 10 cm

F6.84 Gorgonians recorded at Pulau Kendi. A: Sea Fan (*Guaiagorgia* sp.), B: Sea Fan (*Echinogorgia* sp.), C: Sea Fan (*Subergorgia* sp.), D: Sea Fan (*Melithaea* sp.), E: Magnificent Sea Anemone (*Heteractis magnifica*)

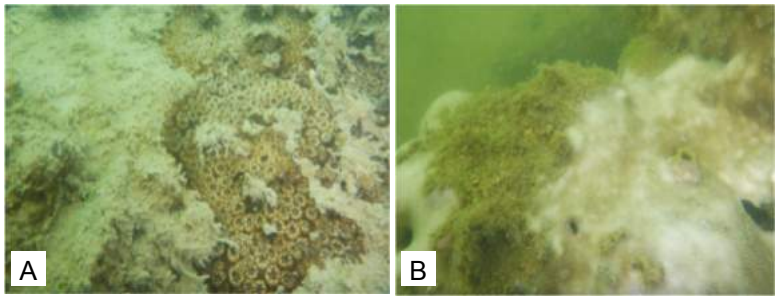
In terms of dive sites, the highest count of hard corals was recorded at C3, with all 13 taxa recorded. C2 was recorded with nine taxa, while both C1 and C4 were recorded with eight genera. The gorgonians, on the other hand, were mostly recorded at C1 and C2, while C3 was only recorded with one genus i.e. Sea Fan (*Echinogorgia* sp.). There were no gorgonians recorded at C4 during the survey. The soft corals were also found only at C2.

Coral cover ranged from 0 to 60 m, with the highest coral cover being recorded at C4. It should be noted that the corals in most of the stations were scattered along the transect line. The least coral cover was recorded at C3, where the reef extended up to 10 m only. Strong wave action was observed at C1, thus limiting the dominance of the area to gorgonians. On the other hand, other stations recorded dominance of scleractinian corals, especially at C4 and C2.

According to Chou *et al*. (1994), the range of the coral health status can be divided into four categories based on percentage of live coral cover as below:

- Excellent: > 75%
- Good: 50 – 75%
- Fair: 25 – 50 %
- Poor: > 25%

During the survey, the live coral cover in Pulau Kendi was <30% of the total coral area, indicating “fair” coral health. Corals are highly depended on light and clear water to gain energy. The health status of the corals in Pulau Kendi was most likely influenced by the high siltation that blocked direct sunlight. Chronic siltation on corals can directly affect them through reduction of photosynthesis and growth (Telesnicki and Goldberg, 1995). During the current survey, high levels of siltation were observed at all stations (F6.85A). Studies showed that decreases in the clarity of the water column caused by high sedimentation are one of the most important factors limiting reef development (Rogers, 1990). In addition, Dodge *et al*. (1974) had reported that coral growth is closely associated to the resuspension of bottom sediments. Coral growth rates decreased from 1 to 0.6 cm/year when resuspension increased from 0.005 to 0.011 kg/m^2/day.



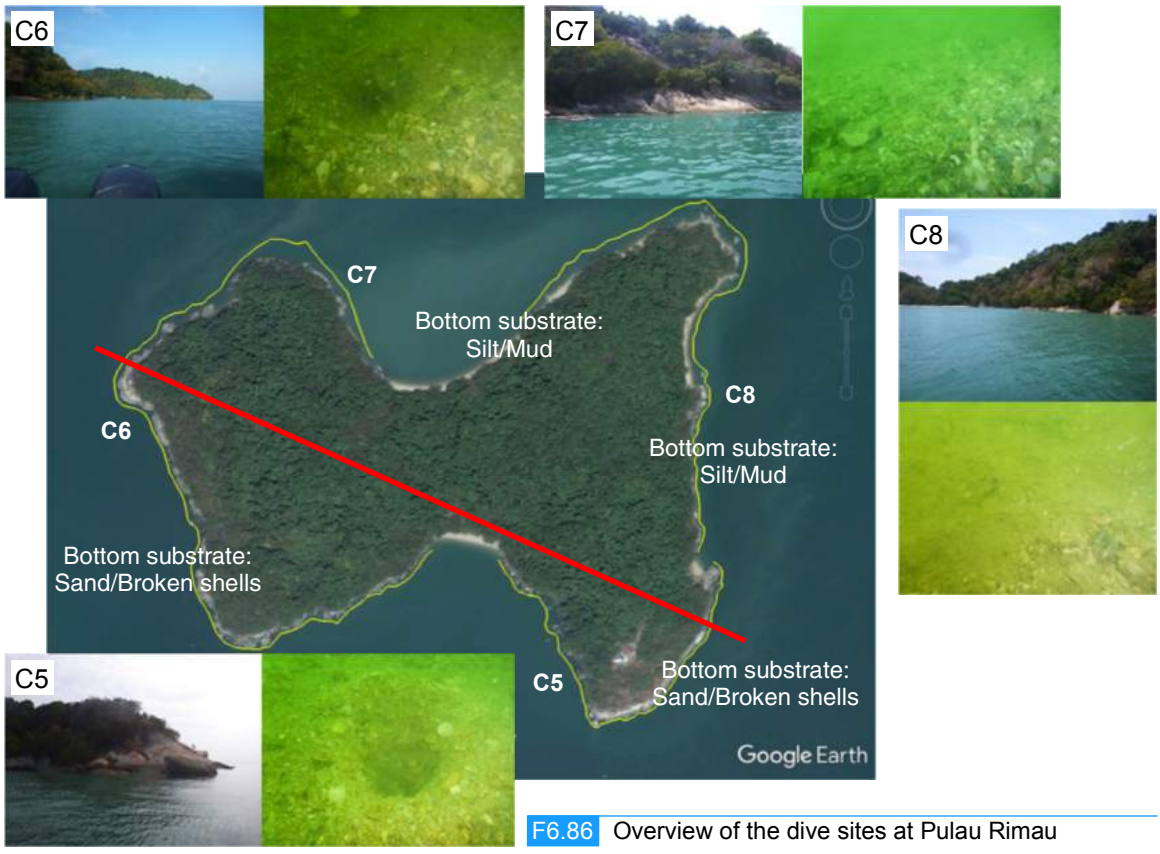
Note: The pictures were taken from an average focus distance of 10 cm

F6.85 Siltation and bleaching on coral reefs in Pulau Kendi

In addition, coral bleaching was also observed during the survey (F6.86B). Bleaching is an indication of stress response of corals to various disturbances such as sedimentation and inorganic nutrients (Buchheim, 1998). Bleaching occurs when corals lose 60 to 90% of their zooxanthellae (Glynn, 1996). Corals depend on photosynthetic zooxanthellae for nutrients and if zooxanthellae loss is prolonged, the coral host eventually dies (Buchheim, 1998). However, the level of bleaching recorded during the survey was found to be low as compared to the total reef area.

ii) Pulau Rimau

Pulau Rimau is located at the south-eastern part of Penang Island, and its location is adjacent to the main island. The terrestrial feature of the island is forested hill. Great rock formations were found surrounding the island. Sandy beaches were only observed at the northern and southern bays of the island (F6.86). Based on the diving survey, the bottom sediment at the northern and eastern parts of the island were generally of mud and silt, while the southern and western were found to be sand and broken shells.



F6.86 Overview of the dive sites at Pulau Rimau

The corals on this island are fewer than the Pulau Kendi, possibly due to its location. The survey on the shallow reefs recorded a total of seven taxa of hard corals, five taxa of gorgonians and single taxa of soft coral (T6.43).

T6.43 Coral species recorded at Pulau Rimau

Type	Family	Species	Common Name	Station			
				C5	C6	C7	C8
Gorgonians	Ellisellidae	*Subergorgia* sp.	Sea Fan	+		+	+
	Gorgoniidae	*Guaiagorgia* sp.	Sea Fan	+	+	+	
	Melithaeidae	*Melithaea* sp.	Sea Fan	+	+	+	
	Plexauridae	*Echinogorgia* sp.	Sea Fan	+	+	+	+
		Plexaura sp.	Sea Fan		+		
Soft Coral	Stichodactylidae	*Stichodactyla* sp.	Giant Carpet Anemone			+	+
Hard Coral	Caryophylliidae	*Caryophyllia* sp.	Cup Coral	+	+	+	
	Faviidae	*Favia* sp.	Moon Coral	+	+	+	+
	Faviidae	*Favites* sp.	Star Coral	+	+	+	+
	Faviidae	*Monstastrea* sp.	Pineapple Coral		+	+	+
	Merulinidae	*Goniastrea* sp.	Lesser Star Coral	+	+	+	
	Poritidae	*Goniopora* sp.	Anemone Coral	+	+	+	+
	Poritidae	*Porites* sp.	Boulder Coral	+	+	+	+

Note: '+' – present

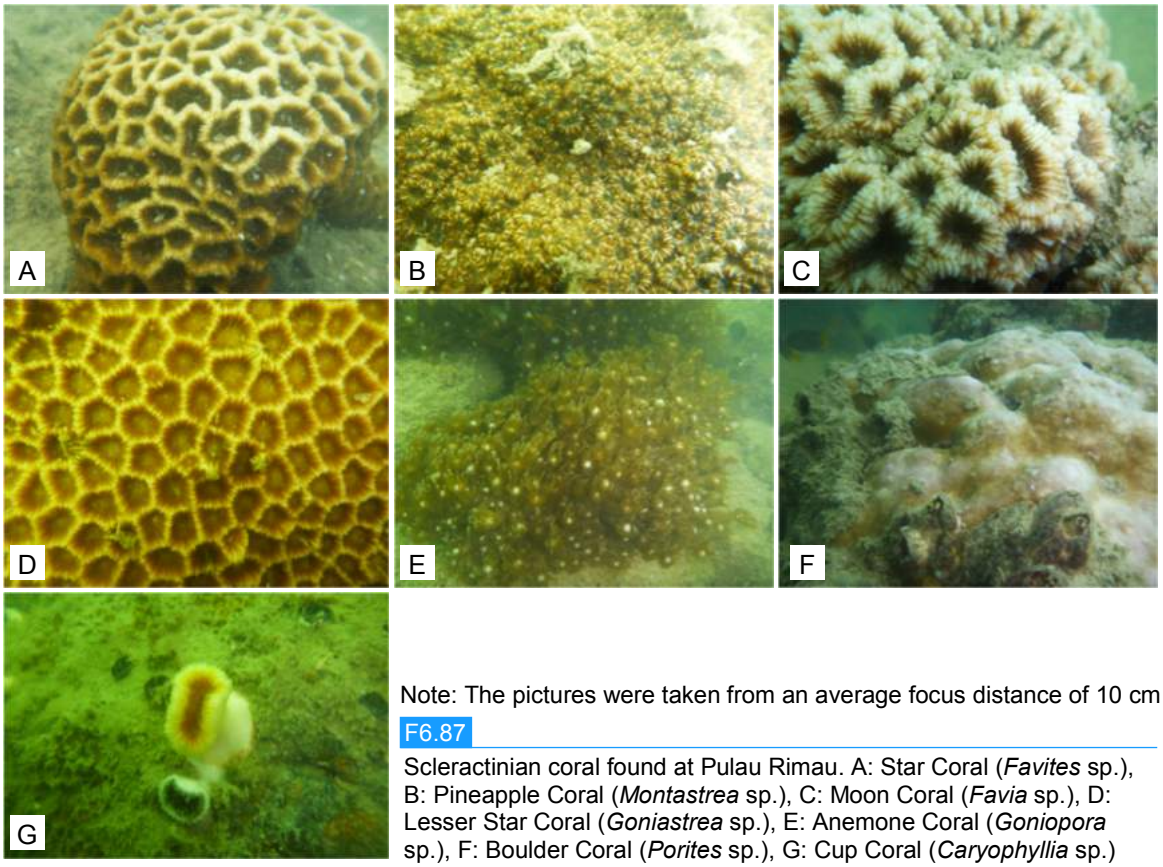
From seven taxa of hard corals, most widespread were the Boulder Coral (Porites sp.) and Anemone Coral (Goniopora sp.) (F6.87). As for the gorgonians, the recorded taxa include *Echinogorgia* sp., *Guaiagorgia* sp., *Subergorgia* sp., *Melithaea* sp. and *Plexaura* sp., and were found all around the island (F6.88A, B and C). As for soft corals, only Giant Carpet Anemone (*Stichodactyla* sp.) from family Stichodactylidae were recorded (F6.88D).

The highest number of hard corals was recorded at C6 and C7, both with seven genera, followed by C5 with six genera, and the least was at C8 with only five genera. In comparison, the number of hard corals at this island was lower as compared to Pulau Kendi. On the other hand, the gorgonians were recorded abundantly at C5, C6 and C7, except at C8 where only two genera recorded as compared to four genera recorded in aforementioned locations. The Giant Carpet Anemone (*Stichodactyla* sp.) was only recorded at C7 and C8.

Coral cover at C6 ranged from 0.5 to 5.0 m from low watermark and going vertically down. The corals, especially the scleractinians and gorgonians, were extremely scattered and most were found growing between and on the boulders themselves. In terms of gorgonians, each boulder, with average area of 1 m^2, was found to support about 1 to 2 gorgonians.

The most number of genera was recorded at C7, even though they were mostly found within range of 0.5 to 2.5 m from low watermark. Due to the area being protected from strong wave action, a higher number of scleractinian corals was observed.

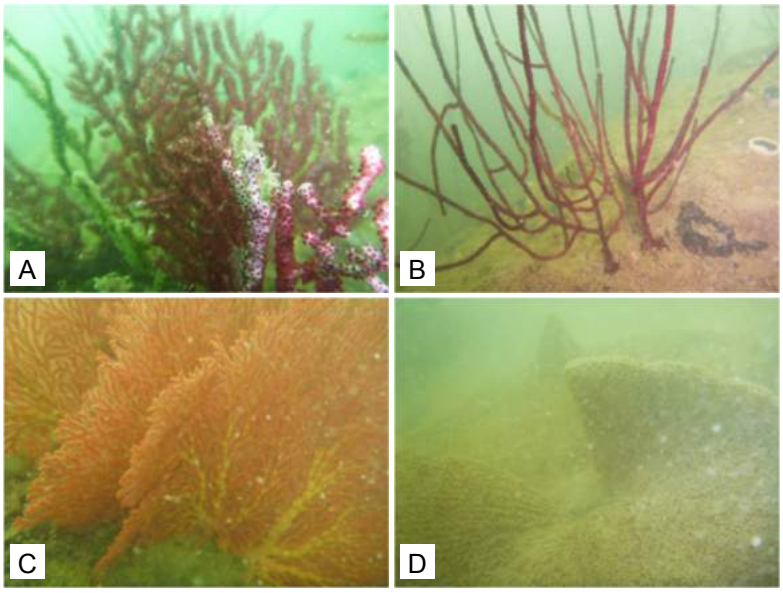
The coral cover at C8 was also found within the range of 0.5 to 5.0 m from low watermark going vertically down. The area was susceptible to strong wave action, thus limiting the presence of scleractinian corals. However, gorgonians were found scattered abundantly on top and between boulders at a density of 5 to 6 gorgonians/m^2.



Note: The pictures were taken from an average focus distance of 10 cm

F6.87

Scleractinian coral found at Pulau Rimau. A: Star Coral (*Favites* sp.), B: Pineapple Coral (*Montastrea* sp.), C: Moon Coral (*Favia* sp.), D: Lesser Star Coral (*Goniastrea* sp.), E: Anemone Coral (*Goniopora* sp.), F: Boulder Coral (*Porites* sp.), G: Cup Coral (*Caryophyllia* sp.)



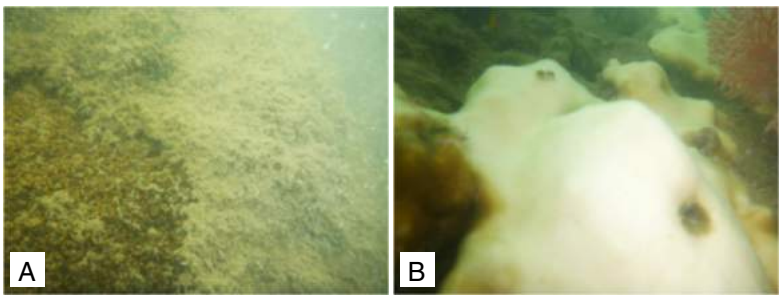
Note: The pictures were taken from an average focus distance of 10 cm

F6.88

Gorgonians and soft coral recorded at Pulau Kendi. A: Sea Fan (*Guaiagorgia* sp.), B: Sea Fan (*Echinogorgia* sp.), C: Sea Fan (*Melithaea* sp.), D: Giant Carpet Anemone (*Stichodactyla* sp.)

C5 was also dominated by the gorgonians due to strong wave action. Coral cover ranged from 0.5 to 5.0 m from low watermark, with most of gorgonians found scattered on top and between boulders, at an average density of 5 gorgonians/m^2. However, the bottom sediment after 3 m was found to be made of sand and broken shells.

The coral cover in Pulau Rimau was significantly lower i.e. <5% as compared to its counterpart in Pulau Kendi. The coral cover in the area was reported as “poor” according to Chou *et al*. (1994). The location of the island adjacent to the island of Penang Island may have a direct effect on its coral distribution. The main disturbance on the coral reefs comes in form of siltation and sedimentation, which is caused by coastal development and shipping activities, overfishing, tourism activities and also increases in sea water temperature (climate change) (Rogers, 1990; Birkeland, 1997; Talbot and Wilkinson, 2001; Burke *et al*., 2011). High levels of siltation were observed at all stations - much higher as compared to Pulau Kendi (F6.89A). Any decrement on the water column clarity would have a significant impact on the growth rates of the coral (Rogers, 1990). In addition, bleaching events were observed in Pulau Rimau. However, the bleaching events were minor in comparison to the total reef area (F6.89B).



Note: The pictures were taken from an average focus distance of 10 cm

F6.89

Bleaching and siltation on coral reefs in Pulau Rimau

6.3.1.2.4 Associated Marine Fauna

Coral reefs support a diverse range of fauna, both vertebrates as well as invertebrates. This is because apart from playing a major role in protecting shorelines from storms and waves, they also act as refuges and feeding/nursery grounds. The diversity of marine life is directly proportional to the complexity of the coral ecosystem i.e. the more complex and diverse the reefs, the more species the ecosystem supports (Luckhurst and Luckhurst, 1978). In addition, Bell *et al.* (1985) reported a positive correlation between coral cover and coral fish diversity in some fish communities. The discussion on the associated marine fauna is divided into both islands i.e. Pulau Kendi and Pulau Rimau.

- Reef Fish

i) Pulau Kendi

During the survey in Pulau Kendi, a total of 62 fish species belonging to 22 families were recorded. The highest number of fish species were observed at station C1 with 46 species, followed by station C3 (32 species) and station C2 (24 species). Details of the fish species recorded were provided in T6.44. Most of the species recorded were common reef fishes such as Damselfish and Rabbitfish that are important in reef ecosystem (F6.90). Their foraging help maintain the balance between coral and macroalgal (Burkepile and Hay, 2008).

Other than reef fishes, high-value commercial fish species such as groupers and snappers were spotted in the Pulau Kendi reef. This is probably the main reason why these islands are among the famous angling hotspots in Penang. As a productive ecosystem, reef areas provide food and shelter as well as nursery grounds for these fishes. Protection of these reef areas would enable it to sustain human activities such as angling and fishing.

T6.44 Fish species recorded at Pulau Kendi

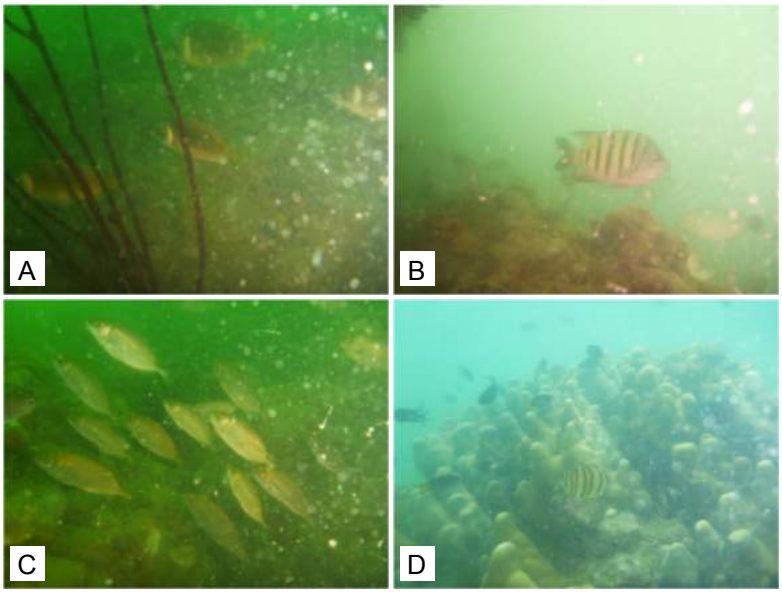
Family	Species	Common Name	Station			
			C1	C2	C3	C4
Acanthuridae	*Acanthurus* sp.	Surgeonfish	+	+	+	
	Ctenochaetus strigosus	Gold-Ring Bristletooth		+		
Apogonidae	*Apogon doederleini*	Doederlein's Cardinalfish	+		+	
	Apogon sp.	Cardinalfish	+	+	+	+
	Ostorhinchus sp.	Stripe Cardinalfish		+		
Caesionidae	*Caesio cuning*	Redbelly Yellowtail Fusilier	+			
	Caesio sp.	Fusilier	+			
	Caesio xanthonota	Yellowback Fusilier	+		+	
	Pterocaesio marri	Mars Fusilier	+			
	Elagatis bipinnulata	Rainbow Runner	+			
Carangidae	*Scomberoides* sp.	Queenfish	+			
	Selaroides leptolepis	Yellowstripe Scad	+			
Chaetodontidae	*Chaetodon octofasciatus*	Redtail Butterflyfish				+
	Chaetodon collare	Redtail Butterflyfish	+	+	+	+
	Chelmon rostratus	Copperband Butterflyfish	+	+	+	+
	Heniochus acuminatus	Longfin Bannerfish	+	+	+	+
	Heniochus chrysostomus	Threeband Pennantfish	+			
	Heniochus varius	Horned Bannerfish	+			
Gobiidae	*Amblyeleotris steinitzi*	Steinitz's Prawngoby	+	+	+	
	Istigobius decoratus	Decorated Goby		+	+	
Haemulidae	*Diagramma pictum*	Painted Sweetlips	+		+	
	Plectorhinchus gibbosus	Harry Hotlips			+	
	Plectorhinchus sp.	Sweetlips	+	+		+
Hemiramphidae	*Hemiramphus* sp.	Half Beak	+			
Labridae	*Halichoeres margaritaceus*	Weedy Surge Wrasse	+			
	Hemigymnus fasciatus	Five Banded Wrasse		+		
	Thalassoma hardwicke	Sixbar Wrasse			+	
	Thalassoma lunare	Moon Wrasse	+			+
	Thalassoma sp.	Sunset Wrasse		+	+	+
Lutjanidae	*Lutjanus bohar*	Twospot Red Snapper			+	
	Lutjanus quinquelineatus	Five Line Snapper			+	
	Lutjanus vitta	Brownstripe Snapper	+		+	
Monacanthidae	*Monacanthus chinensis*	Filefish				
Mullidae	*Mulloidichthys* sp.	Goatfish			+	
Nemipteridae	*Scolopsis bilineatus*	Twoline Monocle Bream			+	
	Scolopsis ciliatus	White Streak Monocle Bream	+		+	
	Scolopsis frenata	Bridled Monocle Bream	+			
	Scolopsis monogramma	Monogrammed Monocle Bream	+			
	Scolopsis vosmeri	White Cheeked Monocle Bream	+	+	+	+
Pempheridae	*Pempheris* sp.	Sweeper		+		

Note: '+' – present

T6.44 Fish species recorded at Pulau Kendi (cont'd)

Family	Species	Common Name	Station			
			C1	C2	C3	C4
Pomacanthidae	*Pomacanthus annularis*	Bluering Angelfish	+	+	+	+
Pomacentridae	*Abudefduf bengalensis*	Bengal Sergeant	+	+	+	+
	Amphiprion perideraion	Skunk Clownfish		+		
	Amphiprion sp.	Clownfish	+			
	Chaetodon sp.	Butterflyfish			+	
	Chromis sp.	Chromis	+	+	+	+
	Neopomacentrus azysron	Yellowtail Demoiselle	+	+	+	+
	Neopomacentrus cyanomos	Regal Demoiselle	+	+	+	+
	Neopomacentrus sp.	Damsel Fish	+			
Scaridae	*Chlorurus sordidus*	Daisy Parrotfish	+		+	
Scombridae	*Rastrelliger* sp.	Mackerel	+			
Serranidae	*Cephalopholis boenack*	Chocolate Hind	+	+	+	
	Cephalopholis erythrurus	Cloudy Grouper	+			
	Cephalopholis formosa	Blueline Grouper	+	+	+	+
	Cephalopholis fuscoguttatus	Brown Marbled Grouper	+		+	
	Diploprion bifasciatum	Barred Soapfish	+	+	+	+
	Epinephelus bleekeri	Duskytail Grouper	+			
	Epinephelus coioides	Orange-Spotted Grouper	+			
	Epinephelus fasciatomaculosus	Rock Grouper	+			
Siganidae	*Siganus canaliculatus*	White-Spotted Spinefoot	+			
	Siganus javus	Streaked Spinefoot	+	+	+	
Sphyraenidae	*Sphyraena* sp.	Barracuda	+			

Note: '+' – present



Note: The pictures were taken from an average focus distance of 10 cm

F6.90

Fish observed at Pulau Kendi. A: White Cheeked Monocle Bream (*Scolopsis vosmerii*), B: Bengal Sergeant (*Abudefduf bengalensis*), C: White-spotted Spinefoot (*Siganus canaliculatus*), D: Eight-banded Butterflyfish (*Chaetodon octofasciatus*)

ii) Pulau Rimau

Reef fish found at Pulau Rimau was represented by 25 species that belonged to 13 families (T6.45). In terms of station, the highest number of species was observed in C5 with 19 species, whereas the lowest was in C6 and C8, of which both recorded 13 species. The fish were found to be small in size, possibly indicating the area as forage and shelter area. The taxa are lower as compared to Pulau Kendi, which could be probably attributed to low visibility due to high-suspended sediment levels. The fish community here was dominated by reef fishes i.e. Damselfish, Wrasse and Cardinalfish, although commercial fish species such as Groupers were also present (F6.91). The island was also a favoured spot for angling enthusiasts, though most of them preferred Pulau Kendi due to its relatively undisturbed condition.

T6.45 Fish species recorded at Pulau Rimau

Family	Species	Common Name	Station			
			C5	C6	C7	C8
Acanthuridae	*Acanthurus* sp.	Surgeonfish	+		+	
Apogonidae	*Apogon* sp.	Cardinalfish	+	+	+	+
Chaetodontidae	*Chelmon rostratus*	Copperband Butterflyfish	+		+	
	Heniochus acuminatus	Longfin Bannerfish			+	+
Gobiidae	*Amblyeleotris steinitzi*	Steinitz's Prawngoby	+			
	Istigobius decoratus	Decorated Goby	+	+	+	+
Labridae	*Thalassoma lunare*	Moon Wrasse	+	+		+
	Thalassoma sp.	Sunset Wrasse	+	+		
Lutjanidae	*Lutjanus vitta*	Brownstripe Snapper	+			
Monacanthidae	*Monacanthus chinensis*	Filefish	+			+
Nemipteridae	*Scolopsis bilineatus*	Twoline Monocle Bream		+		
	Scolopsis vosmeri	White Cheeked Monocle Bream			+	
Pomacanthidae	*Pomacanthus annularis*	Bluering Angelfish	+	+	+	+
Pomacentridae	*Abudefduf bengalensis*	Bengal Sergeant	+	+	+	+
	Amphiprion sp.	Clownfish	+			
	Chaetodon sp.	Butterflyfish	+	+		
	Chromis sp.	Chromis	+	+	+	+
	Neopomacentrus azysron	Yellowtail Demoiselle	+	+	+	+
	Neopomacentrus cyanomos	Regal Demoiselle	+	+	+	+
Scaridae	*Chlorurus sordidus*	Daisy Parrotfish		+		+
Serranidae	*Cephalopholis boenack*	Chocolate Hind	+			
	Cephalopholis formosa	Blueline Grouper	+			+
	Diploprion bifasciatum	Barred Soapfish			+	
Siganidae	*Siganus canaliculatus*	White-Spotted Spinefoot			+	
	Siganus javus	Streaked Spinefoot	+	+	+	+

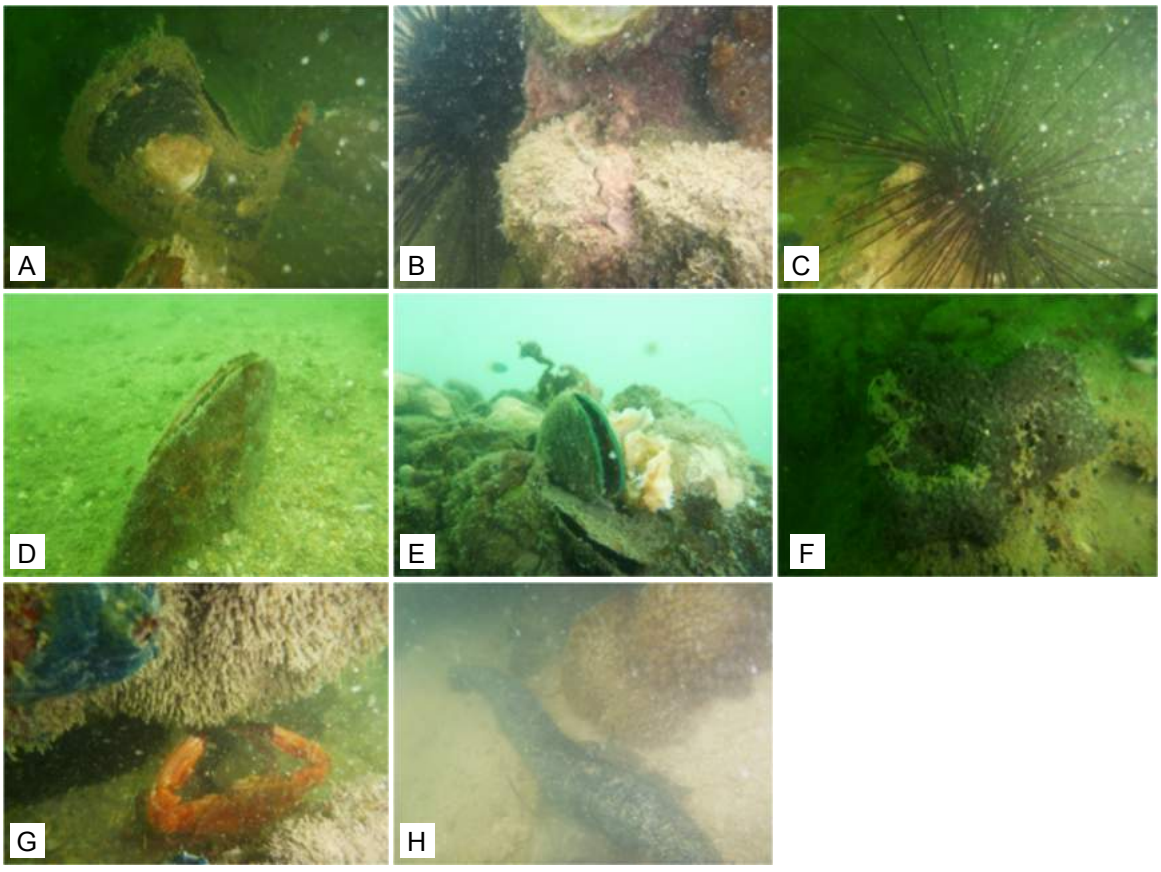
Note: '+' – present

F6.91 Fish observed at Pulau Rimau. A: Yellowtail Demoiselle (*Neopomacentrusazysron*), B: Decorated Goby (*Istigobius ecorates*), C: Twospot Red Snapper (*Lutjanus bohar*)

- Invertebrates

i) Pulau Kendi

In consonance with its relatively disturbed state, there were limited varieties of invertebrates in Pulau Kendi reefs. Most of these are reef-based organisms that rely on other related organisms for forage. A total of 30 taxa of invertebrates was recorded from the current survey, comprising 14 Mollusca, eight Porifera, three taxa from each Arthropoda and Echinodermata as well as a single taxa from Tunicata and Annelida, respectively (F6.92). Details of the invertebrate species recorded are provided in T6.46.



F6.92 Invertebrate found at Pulau Kendi. A: Wing Oyster (*Pteria* sp.), B: Zig Zag Oyster (*Lopha* sp.), C: Long Spines Urchin (*Diadema setosum*), D: Pen Shell (*Pinna* sp.), E: Green Mussel (*Perna viridis*), F: Sponge (*Dysidea* sp.), G: Crab (*Charybdis* sp.), H: Sea Cucumber (*Holothuria* sp.)

T6.46 Invertebrate and associated coral species recorded at Pulau Kendi

Taxa	Genera/Species	Common Name	Station			
			C1	C2	C3	C4
Annelida	*Sabellastarte* sp.	Tube Worm	+		+	
Arthropoda (Crustacea)	*Balanus* sp.	Barnacle	+	+	+	+
	Charybdis sp.	Swimming Crab	+	+		
	Clibanarius sp.	Hermit Crab		+		
Chordata (Tunicata)	*Didennum* sp.	Colonial Tunicates		+		
Echinodermata	*Diadema setosum*	Sea urchin	+	+	+	+
	Echinothrix spp.	Sea Urchin	+	+		+
	Holothuria sp.	Sea Cucumber	+	+	+	+
Mollusca (Bivalvia)	*Aequipecten* sp.	Scallop		+		
	Anadara sp.	Cockle		+		
	Atrina sp.	Pen Shell			+	+
	Chlamys sp.	Scallop	+		+	
	Crassostrea sp.	Oyster	+	+	+	+
	Lopha cristagalli	Coxcomb Oyster	+	+		+
	Lopha sp.	Zig Zag Oyster	+	+	+	+
	Perna viridis	Green Mussel	+	+	+	+
	Pinna sp.	Pen Shell	+	+	+	+
	Pteria sp.	Wing Oyster	+	+	+	+
	Tridacna sp.	Clam	+		+	+
	Saccostrea sp.	Rock Oyster		+	+	
Mollusca (Gastropoda)	*Phenacovolva* sp.	Sea Snail		+		
	Cypraea sp.	Cowry Snail		+		
Porifera	*Callyspongia* sp.	Purple Sponge	+	+		+
	Dysidea sp.	Sponge	+	+		
	Haliclona sp.	Branching Sponge			+	+
	Leucosolenia sp.	Tubular Sponge		+		
	Neopetrosia sp.	Blue Jorunna Sponge	+			
	Axinella aruensis	Brown sponge	+	+	+	
	Plakortis sp.	Sponge	+			
	Cinachyrella sp.	Golf Ball Sponge			+	+

Note: '+' – present

Among the stations in Pulau Kendi, C2 was recorded with highest taxa i.e. 22 taxa. This is followed by C1 with 19 taxa and C3 with 16 taxa. Invertebrates were also found to be higher in Pulau Kendi as compared to Pulau Rimau. One of the possible reasons is the undisturbed condition of Pulau Kendi relative to Pulau Rimau, which is situated nearer to the main island of Penang. The corals in Pulau Kendi, which are more abundant and healthier than in Pulau Rimau, probably also play an important role in providing habitats for these invertebrates.

Some of the most abundant taxa that could be found at the study area include barnacles (*Balanus* sp.), Sea urchin (*Diadema setosum*), Oyster (*Crassostrea* sp.), Zig Zag Oyster (*Lopha* sp.), Pen Shell (*Pinna* sp.) and Wing Oyster (*Pteria* sp.). The most abundant Invertebrates were Pteriids. A study by Alagarswami and Victor (1976) showed that pteriids can tolerate a wide range of salinities, though most of them have a preference for full salinity seawater (35 ppt). In addition, Pteriids also are often found associated with other organisms such as sponges, hydroids, polychaetes, lamellibranches, amphipods, decapods, and echinoderms that contribute to their diverse distribution (Cheah, 2007).

ii) Pulau Rimau

Pulau Rimau was recorded with 18 taxa that belonged to four families (T6.47 and F6.93). Among the four families, Mollusca were recorded with the most number of taxa i.e. nine taxa, followed by Porifera with six taxa. On the other hand, Arthropoda (Crustacea) was recorded with two taxa, while the least number recorded was Echinodermata with only a single taxon. Notwithstanding, the highest taxa were recorded in C7 with 13 taxa, while the lowest was recorded in C8 with eight taxa.

The survey undertaken in Pulau Rimau also recorded dominance of Pteriids as compared to other invertebrate taxa. Pen Shell (*Pinna* sp.) and Wing Oyster (*Pteria* sp.) and Oyster (*Crassostrea* sp.) were mostly found in all stations. In addition, the survey recorded fewer numbers of invertebrates as compared to those in Pulau Kendi. The main reason was probably the low visibility that was caused by high levels of sediment, particularly the area adjacent to the main island of Penang.

T6.47 Invertebrate and associated coral species recorded at Pulau Rimau

Taxa	Genera/Species	Common Name	Station			
			C1	C2	C3	C4
Arthropoda (Crustacea)	*Balanus* sp.	Barnacle	+	+	+	+
	Charybdis sp.	Swimming Crab			+	+
Echinodermata	*Diadema setosum*	Sea urchin	+	+	+	+
Mollusca (Bivalvia)	*Anadara* sp.	Cockle				+
	Atrina sp.	Pen Shell		+		+
	Crassostrea sp.	Oyster	+	+	+	
	Lopha cristagalli	Coxcomb Oyster			+	
	Lopha sp.	Zig Zag Oyster	+		+	+
	Perna viridis	Green Mussel	+		+	
	Pinna sp.	Pen Shell	+	+	+	
	Pteria sp.	Wing Oyster		+	+	+
	Sarcostrea sp.	Rock Oyster	+	+	+	
Porifera	*Callyspongia* sp.	Purple Sponge	+	+		
	Dysidea sp.	Sponge	+	+		
	Haliclona sp.	Branching Sponge			+	
	Leucosolenia sp.	Tubular Sponge			+	+
	Axinella aruensis	Brown sponge	+		+	
	Plakortis sp.	Sponge	+	+		

Note: '+' – present

F6.93
Invertebrate found at Pulau Rimau. A: Purple Sponge (*Callyspongia* sp.) B: Green Mussel (*Perna viridis*) C: Wing Oyster (*Pteria* sp.), D: Crab (*Charybdis* sp.)

- Turtles

The major areas for turtle landings are located within the Penang National Park, particularly at Pantai Kerachut, Teluk Ketapang, Teluk Kampi and Muka Head beaches. Other areas at the northern part of the island that recorded turtle landings have included Teluk Aling, Teluk Duyung, Teluk Bahang, Moonlight Beach, Batu Ferringhi and Tanjong Bungah. As for the southern part of the island, several beaches in Teluk Kumbar, Gertak Sanggul, Pantai Medan, Teluk Tempoyak and Pantai Belanda are known as areas for turtle landing (F6.94) (DHI Environment, 2014). In addition, a Turtle Conservation Centre is established to protect marine turtles in Pantai Kerachut.

i) Methodology

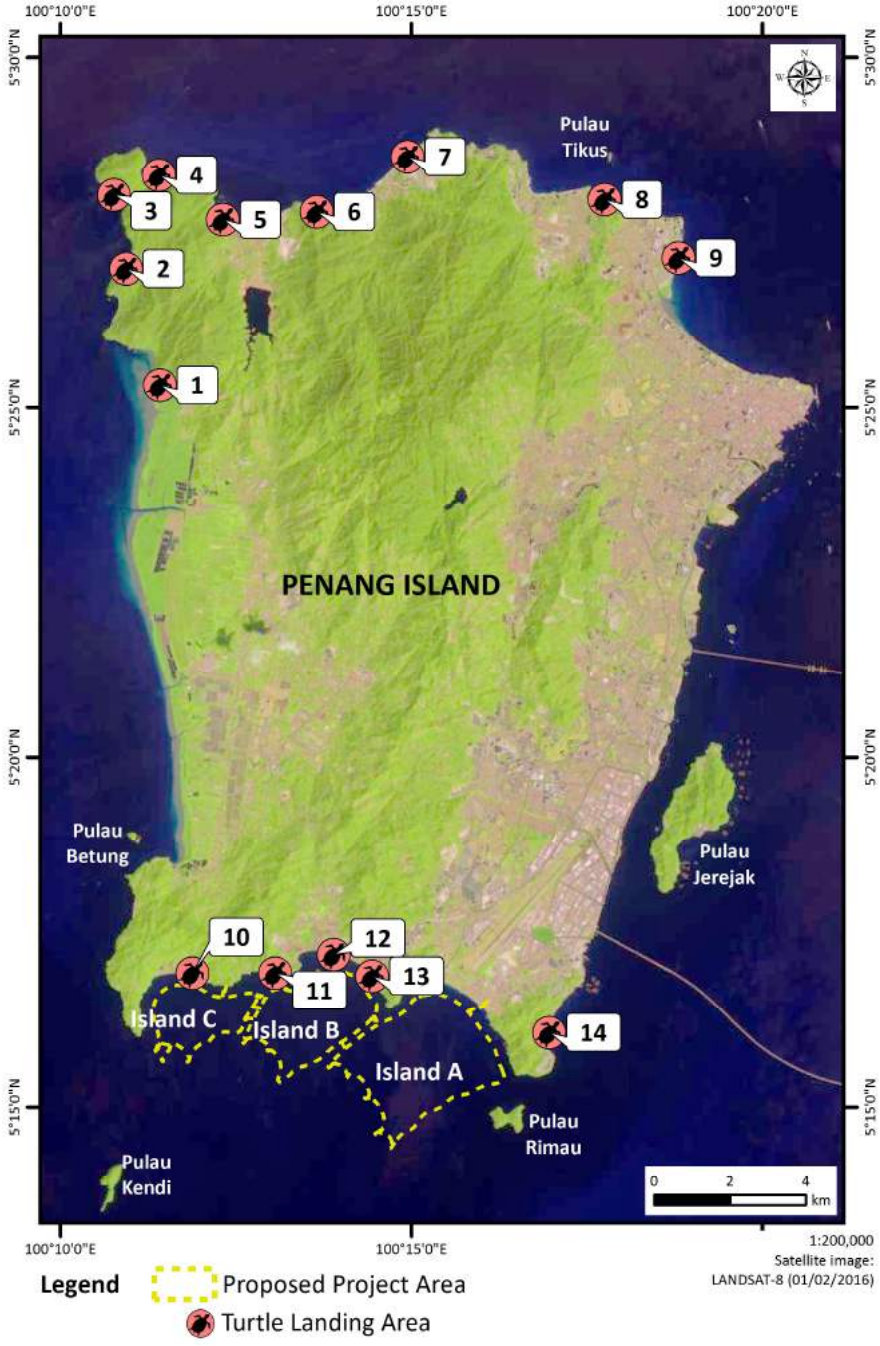
Turtle assessment at south of Penang Island is solely based on secondary data and desktop study. Recorded turtle landings and sightings were obtained from reports, newspapers and journals.

ii) Results

Four species of marine turtles, i.e. the Leatherback (*Dermochelys coriacea*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricata*) and Olive Ridley (*Lepidochelys olivacea*) nest along the coast of Malaysia. Two species of turtles have been recorded in Penang waters, namely Green Turtle (*Chelonia mydas*) and Olive Ridley Turtle (*Lepidochelys olivacea*) (DHI Environment, 2014; Sarahaizad *et al*., 2012). The Green Turtle is listed as Endangered while the Olive Ridley Turtle is listed as Vulnerable in the IUCN (International Union for Conservation of Nature) Red List.

A study by Sarahaizad *et al*. (2012) undertaken at 13 beaches within Penang island i.e. Pantai Kerachut, Teluk Kampi, Batu Ferringhi, Tanjong Bungah, Pantai Medan, Pantai Belanda, Teluk Kumbar, Gertak Sanggul, Moonlight Beach, Teluk Duyung, Teluk Aling, Teluk Bahang and Teluk Ketapang indicated the total number of landings recorded for these areas as in T6.51. The most abundant species was Green Turtle (*Chelonia mydas*), where the major areas for their landings were Pantai Kerachut and Teluk Kampi. Tracks and nests of this species also have been recorded in Batu Ferringhi, Tanjong Bungah, Pantai Medan, Pantai Belanda, Teluk Kumbar, Gertak Sanggul, Moonlight Beach, Teluk Duyung, Teluk

Aling, Teluk Bahang and Teluk Ketapang. As for Olive Ridley Turtle (*Lepidochelys olivacea*), their tracks and nests have been found in Teluk Kumbar, Tanjong Bungah, Pantai Medan, Teluk Duyung and Gertak Sanggul (Sarahaizad *et al*., 2012). DHI Environment (2014) carried out a survey on marine turtles from 2001 until 2014 at the southern beaches of Penang island i.e. Gertak Sanggul, Pantai Belanda, Teluk Kumbar, Pantai Medan and Teluk Tempoyak. The study reported the highest number of turtle landings at Teluk Kumbar (five landings), while other areas only recorded one landing each. The most common species was Olive Ridley Turtle (*Lepidochelys olivacea*). However, there was also one landing of Green Turtle (*Chelonia mydas*) recorded at Pantai Belanda in 2006. Sarahaizad *et al*. (2012) also reported the landings of Olive Ridley Turtle (*Lepidochelys olivacea*) at the southern part of Penang Island.



No.	Location
1	Teluk Kampi
2	Pantai Kerachut
3	Teluk Ketapang
4	Teluk Duyung
5	Teluk Aling
6	Teluk Bahang
7	Batu Ferringhi
8	Tanjung Bungah
9	Tanjung Tokong
10	Gertak Sanggul
11	Pantai Pasir Belanda
12	Teluk Kumbar
13	Pantai Medan
14	Teluk Tempoyak

F6.94
Turtle landing areas in Penang Island

A more recent study of turtle landings in Penang is presented in T6.48. Landings fluctuated from 2010 to 2015, with the highest in 2013 (63 landings) while the lowest was in 2014 (35 landings) (DOF, 2016). In 2015, only one landing of the Olive Ridley was recorded within the impact zone i.e. in Teluk Kumbar. No landings were recorded in 2016 (January to August) at areas within the impact zone.

T6.48 Number of turtle landings recorded in Penang, 2000-2015

Year	Turtle Species	
	Green Turtle (*Chelonia mydas*)	Olive Ridley (*Lepidochelys olivacea*)
2000[1]	-	-
2001[1]	66	-
2002[1]	39	1
2003[1]	47	-
2004[1]	62	1
2005[1]	42	1
2006[1]	71	-
2007[1]	62	1
2008[1]	44	3
2009[1]	73	2
2010[2]	51	-
2011[2]	60	-
2012[2]	50	-
2013[2]	63	2
2014[2]	35	-
2015[2]	60	1

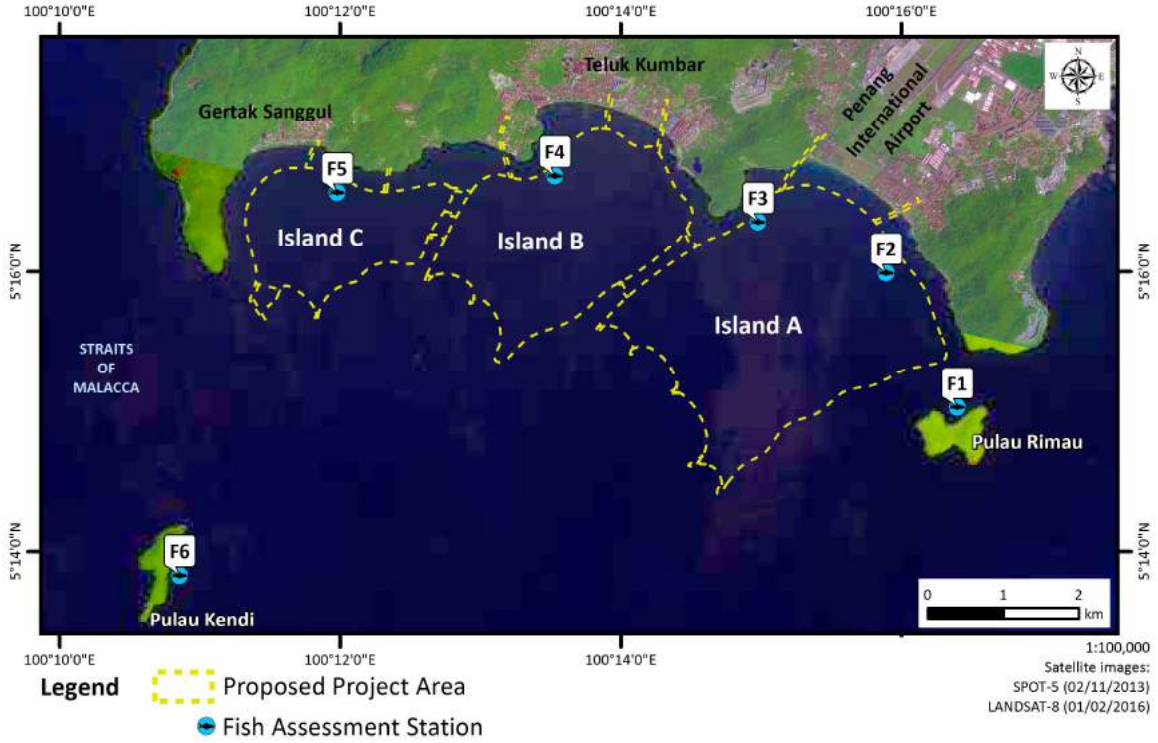
Note: '-' = no data available
Source: [1]Sarahaizad et al., (2012), [2]Department of Fisheries (2016) - Unpublished

■ Fish

A total of six sampling stations was involved (T6.49 and F6.95). The sampling was conducted from 3rd to 9th March 2016. The data that was gathered covered speciation, size/ weight and catch per unit effort of fish.

T6.49 Description of the sampling stations for fish assessment

Station	Coordinates		Description			
	Latitude	Longitude	Date	Time	Tide	Location
F1	05°15.219'N	100°16.671'E	5/3/16	1125	Flood tide	Between Pulau Rimau and Penang Island
F2	05°15.936'N	100°15.920'E	6/3/16	1052	Flood tide	Within proposed reclamation Island A
F3	05°16.478'N	100°13.519'E	7/3/16	1300	Flood tide	Within proposed reclamation Island A
F4	05°16.183'N	100°13.737'E	9/3/16	1140	Flood tide	Within proposed reclamation Island B
F5	05°16.264'N	100°11.912E	8/3/16	1120	Flood tide	Within proposed reclamation Island C
F6	05°14.611'N	100°16.488'E	3/3/16	0910	Flood tide	Off Pulau Kendi



F6.95 Location of the sampling stations for fish assessment

i) Methodology

At each sampling station, the following procedure was employed:

a) trammel nets (three layer netting) with inner net panel with a mesh size of 4.5 cm and two outer net panels with mesh size of 5.0 cm was employed.
b) the net was employed as barrier nets, with both ends affixed to anchor or stakes (F6.96).
c) the length and width of the nets was about 54 and 2.7 m, respectively.
d) the net was affixed for one hour.
e) fish caught was collected, separated and identified up to the genus or species level based on keys in De Bruin *et al*. (1995), Mohsin *et al*. (1993), Kong (1998) and the Fishbase.org website.
f) the weight and length measurements were recorded for all the fish collected. The total length (TL) of the fish was measured from the snout until the outer tip of the tail using measuring tape. A portable weighing scale was used for weight measurement (F6.97).
g) photographs of the representative fish specimens will be taken. Some fish specimens were preserved in 10% formalin solution for documentation and record purposes.

F6.96
Trammel nets employed at the study area

F6.97
Length (cm) and Weight (g) Measurement of fish specimen

ii) Results

A total of 186 individuals of fish, 11 individuals of crustaceans (shrimp, mantis shrimp and crab) and four individuals of cephalopods (cuttlefish) were caught at the study area. The fish caught belonged to 19 families and comprised of 36 species, while three families and three species were of crustaceans (mantis shrimp, shrimp and crab) and one family and one species of cephalopods (cuttlefish) (T6.50 and F6.98).

Most of the fish caught were largely adult demersal fish. Several pelagic species were also caught, such as Selar (*Atule mate*), Cupak (*Carangoides malabaricus*), Talang (*Scomberoides commersonnianus*), Kebasi (*Anodontostoma chacunda*), Bilis Bunga Air (*Escualosa thoracata*), Kasai (*Thryssa hamiltonii*), Kasai Kucing (*Thryssa mystax*) and Bilis (*Stolephorus commersonii*). In terms of size, the total lengths of fish caught ranged from 5.4 to 39.4 cm while their weights varied from 2 to 272 g.

The highest number of individual species caught was from family Tetraodontidae (pufferfish), which contributed 20.7% of the total number of fish caught. Tetraodontidae was represented by two species i.e. Buntal Pisang (*Lagocephalus lunaris*) and Buntal Askar (*Tetraodon nigroviridis*), of which *Lagocephalus lunaris* was the most dominant with 36 individuals caught (CPUE: 0.247/m^2/hour), compared to 4 individuals for *Tetraodon nigroviridis* (CPUE: 0.027/m^2/hour). Total lengths ranged from 12.6 to 19.9 cm with a composite weight of 3,525 g. Most of the fish caught were adults.

The second highest number of individual species caught was from family Leiognathidae (ponyfish) which contributed 18.1% of the total number of fish caught. Leiognathidae was represented by three species i.e. *Leiognathus brevirostris, Leiognathus blochii* and *Secutor insidiator.*

T6.50 Fish species caught at the study area

Station	Family	Local Name	Scientific Name	No.	Total Length (cm)	Weight (g)	CPUE	
							Density (No./m^2/hour)	Biomass (g/m^2/hour)
F1	Leiognathidae	Kikek	*Secutor insidiator*	8	9.1-10.9	10-15 (CW: 85)	0.055	0.583
		Kikek	*Leiognathus brevirostris*	1	9.4	10	0.007	0.069
	Ariidae	Duri Misai	*Osteogeneiosus militaris*	5	20.5-21.5	55-80 (CW: 330)	0.034	2.263
	Engraulidae	Kasai	*Thryssa hamiltonii*	3	13.2 -15.4	20-30 (CW: 80)	0.021	0.549
	Sphyraenidae	Alu-alu	*Sphyraena jello*	1	39.4	260	0.007	1.783
	Dasyatidae	Ketuka	*Dasyatis zugei*	1	13.2	35	0.007	0.240
	Pristigasteridae	Puput	*Pellona ditchella*	1	16.1	40	0.007	0.274
	Sciaenidae	Gelama Pisang	*Nibea soldado*	1	15.3	40	0.007	0.274
		Tengkerong	*Otolithes ruber*	1	28.3	255	0.007	1.749
		Gelama	*Dendrophysa russelii*	1	13.9	30	0.007	0.206
	Penaeidae	Udang Besar	*Penaeus merguiensis*	1	15.5	30	0.007	0.206
	Portunidae	Ketam Renjong	*Portunus pelagicus*	1	14.7	250	0.007	1.715
	Sepiidae	Sotong	*Sepia* sp.	1	6.0	30	0.007	0.206
F2	Siganidae	Kitang Lada	*Siganus fuscescens*	17	8.6-13.5	10-41 (CW: 437)	0.117	2.997
	Pristigasteridae	Kasai Golok	*Opisthopterus tardoore*	6	12.9-15.5	16-31(CW: 146)	0.041	1.001
	Engraulidae	Kasai	*Thryssa hamiltonii*	3	9.4-10.4	7-10 (CW: 27)	0.021	0.185
	Tetraodontidae	Buntal Pisang	*Lagocephalus lunaris*	2	15.6-15.7	89-93 (CW: 182)	0.014	1.248
	Ariidae	Duri Goh	*Arius platysomus*	2	9.5-10.6	8-12 (CW: 20)	0.014	0.137
	Mugilidae	Kedera	*Liza melinoptera*	2	15.8-16.4	45-58 (CW: 103)	0.014	0.706
	Triacanthidae	Lembu	*Triacanthus nieuhofii*	2	14.1-14.7	46-54(CW: 100)	0.014	0.686
	Leiognathidae	Kikek	*Secutor insidiator*	1	6.7	7	0.007	0.048
		Kikek	*Leiognathus brevirostris*	1	11.0	21	0.007	0.144
		Kikek	*Leiognathus blochii*	1	7.4	6	0.007	0.041
	Haemulidae	Gerut-gerut	*Pomadasys kaakan*	1	14.9	49.0	0.007	0.336
	Sciaenidae	Gelama Pisang	*Nibea soldado*	1	15.1	40	0.007	0.274
		Tengkerong	*Otolithes ruber*	1	28.3	272	0.007	1.866
	Penaeidae	Udang Besar	*Penaeus merguiensis*	1	11.9	11	0.007	0.075
	Sepiidae	Sotong	*Sepia* sp.	1	7.7	67	0.007	0.460

Note: 1. The nets were affixed for 1 hour, 2. Mesh size net were 145.8 m^2 (54 m x 2.7m), 3: CW: Composite weight

T6.50 Fish species caught at the study area (cont'd)

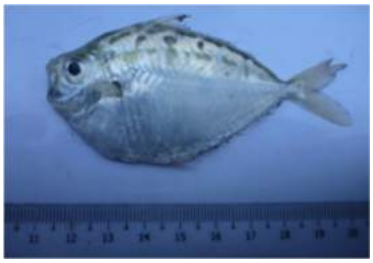
Station	Family	Local Name	Scientific Name	No.	Total Length (cm)	Weight (g)	CPUE	
							Density (No./m²/hour)	Biomass (g/m²/hour)
F3	Tetraodontidae	Buntal Pisang	*Lagocephalus lunaris*	7	14.4-19.9	64-186 (CW: 662)	0.048	4.540
		Buntal Askar	*Tetraodon nigroviridis*	1	13.9	94	0.007	0.645
	Ariidae	Duri Misai	*Osteogeneiosus militaris*	2	18.8-19.9	68-73 (CW: 141)	0.014	0.967
		Duri Otek	*Arius thalassinus*	2	15.2-17.4	39-58 (CW: 97)	0.014	0.665
		Duri Goh	*Arius platysomus*	1	24.2	196	0.007	1.344
	Leiognathidae	Kikek	*Leiognathus blochii*	2	5.4-6.8	3-5 (CW:8)	0.014	0.569
		Kikek	*Secutor insidiator*	1	8.5	12	0.007	0.082
		Kikek	*Leiognathus brevirostris*	1	11.4	21	0.007	0.144
	Sciaenidae	Gelama Merah	*Panna microdon*	1	20.9	76	0.007	0.521
		Gelama	*Johnius belangerii*	1	12.0	24	0.007	0.165
	Haemulidae	Gerut-gerut	*Pomadasys kaakan*	1	15.0	63	0.007	0.432
	Platycephalidae	Baji	*Platycephalus cultellatus*	1	23.1	86	0.007	0.590
	Clupeidae	Bilis Bunga Air	*Escualosa thoracata*	1	10.5	14	0.007	0.096
	Cynoglossidae	Lidah	*Cynoglossus puncticeps*	1	12.4	19	0.007	0.130
F4	Lutjanidae	Tanda	*Lutjanus johnii*	1	19.1	114	0.007	0.782
	Sepiidae	Sotong	*Sepia* sp.	1	9.2	54	0.007	0.370
	Tetraodontidae	Buntal Pisang	*Lagocephalus lunaris*	22	12.6-16.9	51-110(CW: 1684)	0.151	11.550
	Sciaenidae	Tengkerong	*Otolithes ruber*	4	18.8-22.4	53-107 (CW: 345)	0.027	2.366
	Leiognathidae	Kikek	*Leiognathus brevirostris*	4	9.4-10.5	14-22 (CW: 75)	0.027	0.514
	Leiognathidae	Kikek	*Leiognathus blochii*	2	5.7-5.8	2 (CW: 4)	0.014	0.027
	Siganidae	Kitang Lada	*Siganus fuscescens*	2	9.5-15.6	10-65 (CW: 75)	0.014	0.514
	Pristigasteridae	Kasai Golok	*Opisthopterus tardoore*	1	16.7	37	0.007	0.254
	Triacanthidae	Lembu	*Triacanthus nieuhofii*	1	16.1	67	0.007	0.460
	Carangidae	Talang	*Scomberoides commersonnianus*	1	20.2	65	0.007	0.446
	Trichiuridae	Timah	*Trichiurus lepturus*	1	39.0	35	0.007	0.240
	Squillidae	Udang Lipan	*Oratosquilla* sp.	7	10.3-14.5	17-37(CW: 180)	0.048	1.235
	Sepiidae	Sotong	*Sepia* sp.	1	7.2	53	0.007	0.364

Note: 1. The nets were affixed for 1 hour, 2. Mesh size net were 145.8 m^2 (54 m x 2.7m), 3: CW: Composite weight

T6.50 Fish species caught at the study area (cont'd)

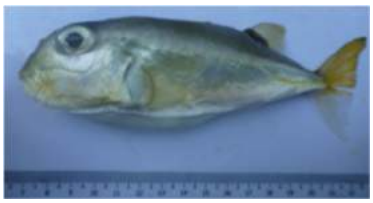
Station	Family	Local Name	Scientific Name	No.	Total Length (cm)	Weight (g)	CPUE	
							Density (No./m^2/hour)	Biomass (g/m^2/hour)
F5	Leiognathidae	Kikek	*Leiognathus brevirostris*	10	8.6-11.0	10-21(CW: 156)	0.069	1.001
		Kikek	*Leiognathus blochii*	2	7.5-7.8	8-6 (CW: 14)	0.014	0.096
		Kikek	*Secutor insidiator*	1	8.5	8	0.007	0.055
	Tetraodontidae	Buntal Pisang	*Lagocephalus lunaris*	5	15.7-18.4	88-145 (CW: 504)	0.034	3.457
		Buntal Askar	*Tetraodon nigroviridis*	3	13.0-19.4	68-225 (CW: 399)	0.021	2.325
	Haemulidae	Gerut-gerut	*Pomadasys kaakan*	3	14.8-15.6	56-62 (CW: 174)	0.021	1.193
	Engraulidae	Bilis	*Stolephorus commersonii*	2	6.5-10.6	3-11 (CW: 14)	0.014	0.096
		Kasai Kucing	*Thryssa mystax*	1	15.9	42	0.007	0.288
	Ariidae	Duri Goh	*Arius platysomus*	2	13.4-17.4	24-58 (CW: 82)	0.014	0.562
		Duri Misai	*Osteogeneiosus militaris*	2	14.6-14.8	30-43 (CW: 73)	0.014	0.501
		Duri Otek	*Arius thalassinus*	1	15.3	33	0.007	0.226
		Duri Kokak	*Arius caelatus*	1	20.7	106	0.007	0.727
	Pristigasteridae	Kasai Golok	*Opisthopterus tardoore*	1	16.5	35	0.007	0.240
	Clupeidae	Kebasi	*Anodontostoma chacunda*	1	14.0	40	0.007	0.274
	Terapontidae	Gegendang	*Terapon jarbua*	1	14.0	52	0.007	0.357
	Sciaenidae	Gelama	*Johnius belangerii*	1	16.5	68	0.007	0.466
	Squillidae	Udang Lipan	*Oratosquilla sp.*	1	13.5	31	0.007	0.213
F6	Ariidae	Goh	*Arius platysomus*	5	18.9-22.6	80-130 (CW: 475)	0.034	3.258
		Duri Misai	*Osteogeneiosus militaris*	1	25.3	155	0.007	1.063
	Clupeidae	Kebasi	*Anodontostoma chacunda*	4	14.8-15.6	50-60(CW: 215)	0.027	1.475
	Terapontidae	Gegendang	*Terapon theraps*	3	14.4-15.6	60 (CW: 180)	0.021	1.235
	Carangidae	Cupak	*Carangoides malabaricus*	1	15.6	55	0.007	0.377
		Pelata	*Atule mate*	1	15.2	40	0.007	0.274
	Sciaenidae	Tengkerong	*Otolithes ruber*	1	23.8	130	0.007	0.892
Total				**193**	**-**	**10,345.0**	**1.324**	**70.988**

Note: 1. The nets were affixed for 1 hour, 2. Mesh size net were 145.8 m^2 (54 m x 2.7m), 3: CW: Composite weight

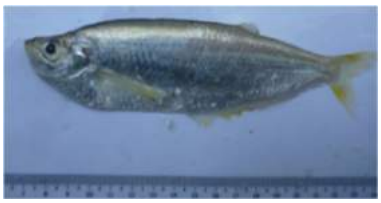

Kikek (*Secutor insidiator*)


Kikek (*Leiognathus brevirostris*)


Kikek (*Leiognathus blochii*)

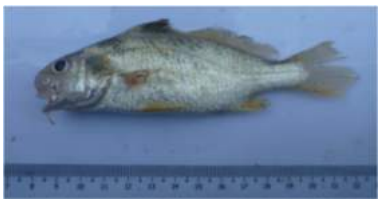

Buntal Kuning (*Lagocephalus lunaris*)

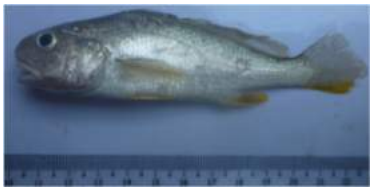

Buntal Askar (*Tetraodon nigroviridis*)


Kasai Golok (*Opisthopterus tardoore*)


Kasai (*Thryssa hamiltonii*)


Puput (*Pellona ditchella*)


Gelama (*Dendrophysa russelii*)


Gelama (*Johnius belangerii*)


Gelama Pisang (*Nibea soldado*)


Gelama Merah (*Panna microdon*)


Tengkerong (*Otolithes ruber*)


Kedera (*Liza melinoptera*)


Tanda (*Lutjanus Johnii*)


Gegendang (*Terapon theraps*)


Gerut-gerut (*Pomadasys kaakan*)

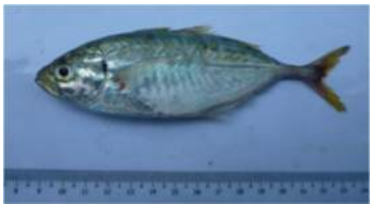

Kebasi (*Anodontostoma chacunda*)


Goh (*Arius platysomus*)

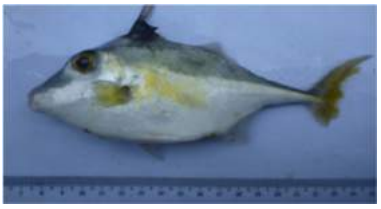

Alu-alu (*Sphyraena jello*)

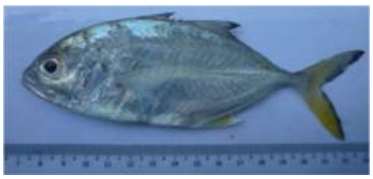

Timah (*Trichiurus lepturus*)

F6.98 Fishes caught at the study area


Pelata (*Atule mate*)


Kitang Lada (*Siganus fuscescens*)

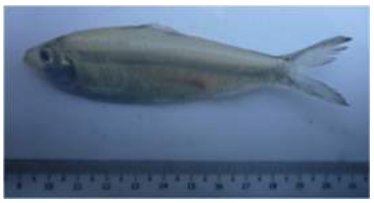

Ikan Lembu (*Triacanthus nieuhofii*)


Cupak (*Carangoides malabaricus*)

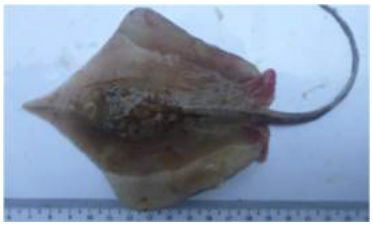

Baji (*Platycephalus cultellatus*)


Lidah (*Cynoglossus puncticeps*)


Duri Misai (*Osteogeneiosus militaris*)


Bilis Bunga Air (*Escualosa thoracata*)


Talang (*Scomberoides commersonnianus*)


Ketuke (*Dasyatis zugei*)

F6.98
Fishes caught at the study area

Among these three species, *Leiognathus brevirostris* was the most dominant with 17 individuals caught (CPUE: 0.117/m^2/hour), followed by *Secutor insidiator* with 11 individuals (CPUE: 0.075/m^2/hour) and *Leiognathus blochii* with 7 individuals (CPUE: 0.048/m^2/hour). Total lengths ranged from 5.4 to 11 cm with a composite weight of 427 g. Most of the fish caught were adults.

Leiognathids (ponyfish) are a bottom-living species and are widely distributed in the coastal waters of tropical and sub-tropical regions (James, 1984). They derive their common name i.e. ponyfish from their highly protractible mouths, which protract dorsorostrally, rostrally or ventrorostrally (Chakrabarty *et al*., 2010). Ponyfish have bacterial light organs, where the transparent patch of skin associated with the organ is usually more developed in males (Paxton and Esch, 1998). These schooling fish have been known to feed on phytoplankton and benthic invertebrates (Woodland *et al*., 2001).

The third highest number of individual species caught was from family Ariidae (catfish) and contributed 12.4% of the total number of fish caught. Ariidae was represented by four species i.e. *Arius caelatus, Arius platysomus, Arius thalassinus* and *Osteogeneiosus militaris.* The highest number of individuals caught were *Arius platysomus* and *Osteogeneiosus militaris* with 10 individuals each (CPUE: 0.068/m^2/hour), while *Arius thalassinus and Arius caelatus* recorded at 3 individuals (CPUE: 0.021/m^2/hour) and 1 individual (CPUE: 0.007/m^2/hour) respectively. Total lengths ranged from 5.4 to 11 cm with a composite weight of 427 g. Most of the fish caught were also juveniles.

The number of individuals caught for other families ranged from 1 to 19 individuals (CPUE: 0.007 to 0.123/m^2/hour). The highest number was contributed by Kasai Golok (*Opisthopterus tardoore*) from family Pristigasteridae, Tengkerong (*Otolithes ruber*) from family Sciaenidae and Kasai (*Thryssa hamiltonii*) from family Engraulidae with 8 individuals (CPUE: 0.055/m^2/hour), 7 individuals (CPUE: 0.048/m^2/hour) and 6 individuals (CPUE: 0.041/m^2/hour) respectively. Most of the fish caught were adults.

As for crustaceans, only 11 individuals were caught which were 2 individuals of Udang Besar (*Penaeus merguensis*), 8 individuals of Udang Lipan (*Oratosquilla* sp.) and 1 individual of Ketam Renjung (*Portunus pelagicus*) (F6.99). *Penaeus merguensis* was caught at F1 and F2, *Oratosquilla* sp. caught at F4 and F5, while *Portunus pelagicus* at F1. Both *Penaeus merguensis* and *Portunus pelagicus* caught were adults, having a carapace length of 11.9 to 15.3 cm (11 to 30 g) and 147.7 cm (250 g) respectively, while *Oratosquilla* sp. caught were juvelines (10.3 to 14.5 cm; 17 to 37 g). Only four individuals of cuttlefish (*Sepia* sp.) were caught at study area. All cuttlefish caught were juveniles, having mantel lengths between 6.0 to 9.2 cm and composite weight of 204 g (30 to 67 g).

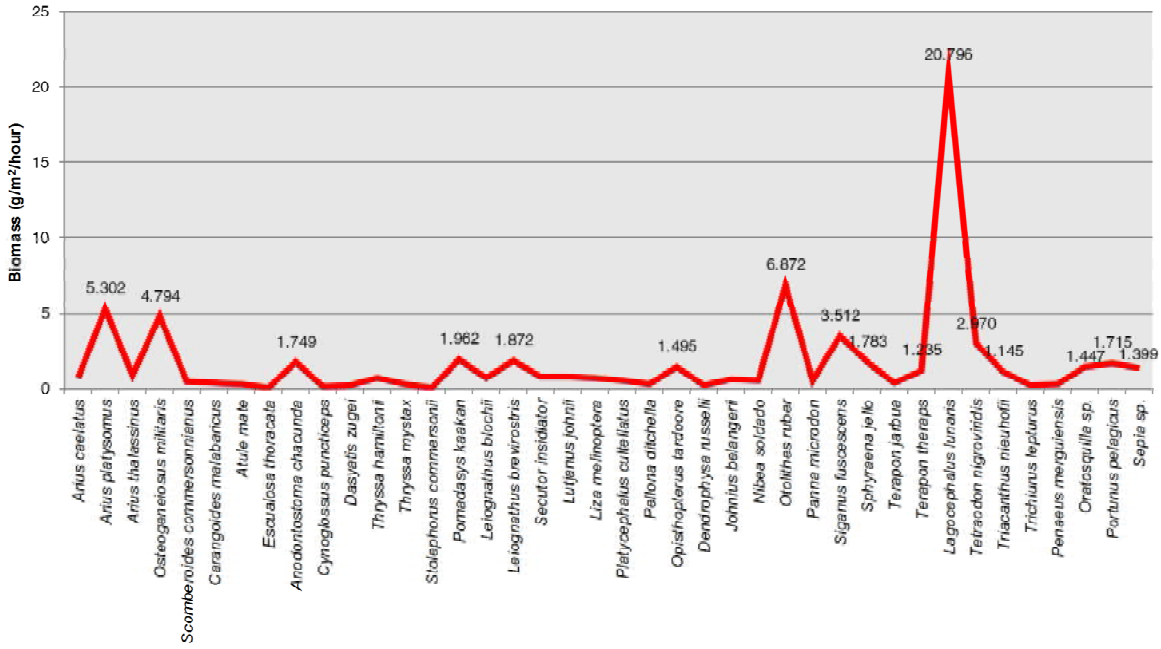
F6.99

Crustacean and Cephalopods Caught at Study Area. A: Udang Besar (*Penaeus merguensis*), B: Udang Lipan (*Oratosquilla* sp.), C: Ketam Renjong (*Portunus pelagicus*), D: Sotong (*Sepia* sp.)

In terms of fish biomass, five species had CPUE value > 3 g/m^2/hour i.e. *Arius platysomus* (CPUE: 5.302 g/m^2/hour), *Osteogeneiosus militaris* (CPUE: 4.794 g/m^2/hour), *Otolithes ruber* (CPUE: 6.872 g/m^2/hour), *Siganus fuscescens* (CPUE: 3.512 g/m^2/hour) and *Lagocephalus lunaris* (CPUE: 20.796 g/m^2/hour). In addition, 11 species had CPUE value between 1 to 3 g/m^2/hour i.e. *Tetraodon nigroviridis* (CPUE: 2.970 g/m^2/hour), *Anodontostoma chacunda* (CPUE: 1.749 g/m^2/hour), *Pomadasys kaakan* (CPUE: 1.962 g/m^2/hour), *Leiognathus brevirostris* (CPUE: 1.872 g/m^2/hour), *Opisthopterus tardoore* (CPUE: 1.495 g/m^2/hour), *Sphyraena jello* (CPUE: 1.783 g/m^2/hour), *Terapon theraps* (CPUE: 1.235 g/m^2/hour), *Triacanthus nieuhofii* (CPUE: 1.145 g/m^2/hour), *Oratosquilla* sp. (CPUE: 1.447 g/m^2/hour), *Portunus pelagicus* (CPUE: 1.715 g/m^2/hour) and *Sepia* sp. (CPUE: 1.399 g/m^2/hour). Other species recorded CPUE values of less than 1 g/m^2/hour (F6.100).

Demersal fish species are commonly bottom dwellers of the sea. According to Ansari *et al.* (1995), the demersal fish community could be classified into two groups i.e. resident and seasonal, where the resident species consisted of juveniles and mature adults while the seasonal species consist of juveniles only. Based on the data collected, it indicates that most of the fish caught at the study area were resident species type. The distribution of demersal fish in Malaysia is commonly related to the availability and distribution of food resources as well as seabed conditions (Sakri *et al*., 2004). Moreover, the study by Ansari *et al.* (1995)

reported the size of demersal fish community also to be partially controlled by the size of the food organisms, where, for instance, smaller epibenthic and infaunal organisms were not suitable for large fish.



F6.100 Fish biomass (CPUE: g/m^2/hour) at the study area

6.4 Existing Human Environment

The proposed Project area is stringed by fishing villages which have already been developed or inhabited. It is thus essential to assess this existing human environment in the surrounding areas stretching from Tanjung Teluk Tempoyak in the east to Tanjung Gertak Sanggul in the west as it is the locals who will finally end up facing whatever consequences arising from the developer's actions. The string of major fishing villages starts off from Kampung Permatang Damar Laut/Kampung Permatang Tepi Laut, weaving through to Kampung Sungai Batu, Teluk Kumbar, Kampung Bagan and culminates in Kampung Gertak Sanggul in the west. Hence, an understanding of the existing socio-economic make-up of a place or locality is essential in order to anticipate the kind of reactions or consequences that may evolve out of a planned action or development.

6.4.1 Overall Socio-economy

This section is written to highlight the socio-economic profile of the local residents who will be impacted and to gauge their level of awareness and perception towards the impending Project. In addition, this study also seeks to establish the level of social acceptability of the area with regards to the Project. The latter is crucial in determining the smooth implementation of the proposed development.

Social statistics on the settlements at the south of Penang Island are practically unavailable. When they are, they would usually be in aggregate form as a part of the constituting local council or district statistics. Hence, there is a need to conduct a social survey for this study, in order to know not only the background of the population in the area but more importantly

their views and assessment of the proposed Project. The latter is crucial for the current impact study as they are among the stakeholders that would be either directly or indirectly impacted by the Project.

The consideration given to the human or socioeconomic features within the confined zone as earmarked for the study area is based on the wisdom that whilst socioeconomic impacts could affect long-distance areas or be borderless and far reaching, it is the population of the immediate surroundings that would bear the head-on or right-of-way impacts, if any, due to their proximity to the development zone or Project site. In addition, it is the concerns of the immediate locals that have to be taken into consideration in order to ensure that a project is socially sound and balanced.

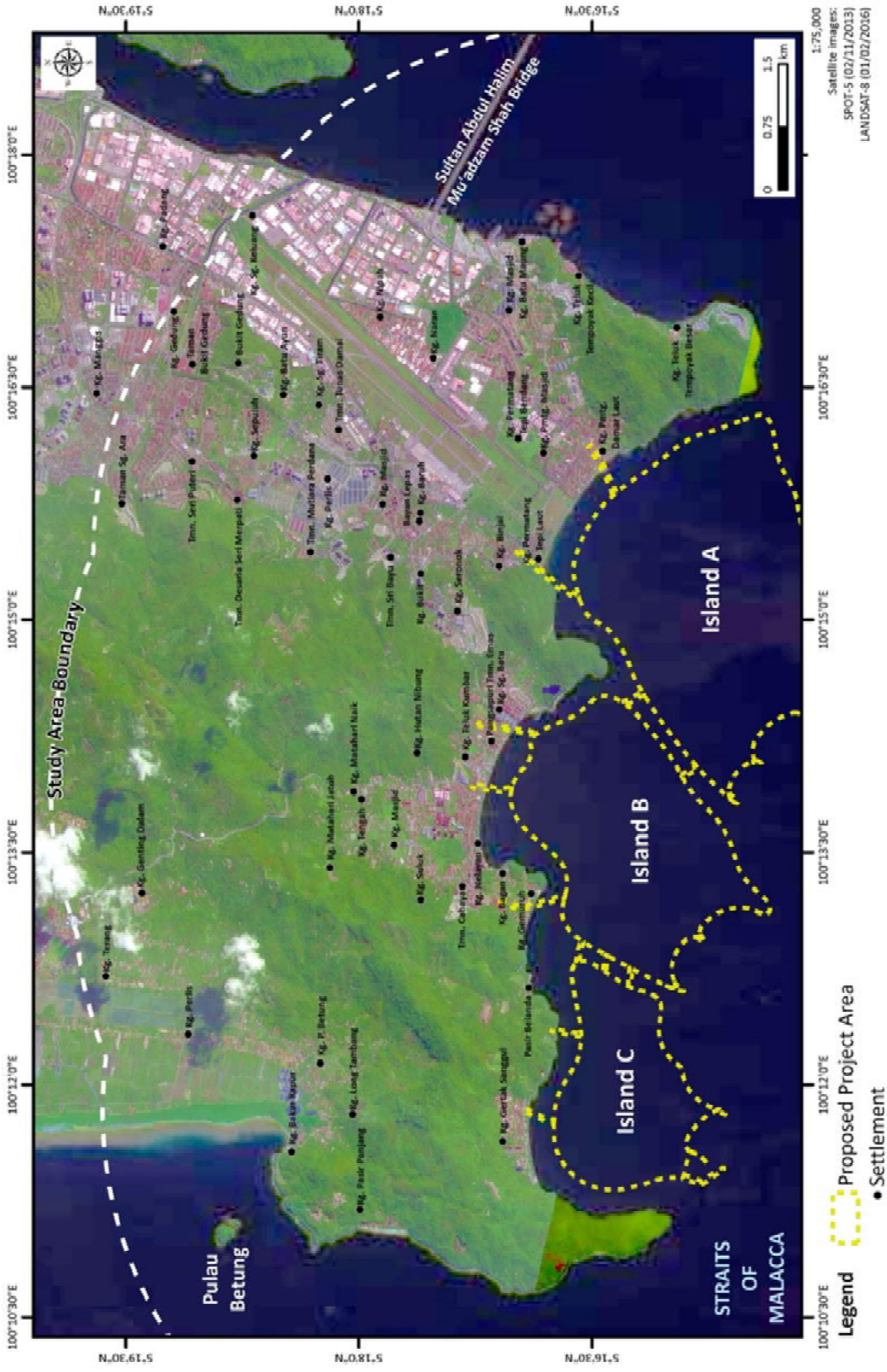
6.4.1.1 Methodology

A specific study such as the current one shall have to rely on generated data collated from surveys. Besides enabling the assemblage of the necessary information sought after, social survey also ensures public participation and input in decision-making at the onset. Hence, social survey was utilised and formed the major method of data collection for this study. It involved a public opinion poll gathered through a questionnaire survey directed to both the affected fishing communities and the general public within the area of 5-km perimeter. The latter group was further sub-divided into other component groups which were thought relevant to the study insofar as to the type of impact they would be facing i.e. the general public per se, the business operators and the beach users. As required, a public dialogue is also conducted to complement the information gathered and to provide the platform for the other members of the society who were not randomly selected for the questionnaire survey to get to know the Project and air their views. Other sources of primary data include Focus Group Discussion (FGD) and informal conversation. The inclusion of the latter was made due to its availability and utilised for the SIA study to ensure greater public involvement and coverage. The settlements covered for this EIA study are shown in F6.101.

6.4.1.2 Sample Size

The questionnaire survey was directed towards a purposive sample of 635 respondents chosen randomly from among the household heads representing the public, business operators, beach users and fishermen in the impacted zone. As such, the households become the statistical population of the study which numbered approximately 15,961 within the 5 km perimeter of the study area (estimated population of 62,250 people divided by the average household size of the area i.e. 3.9 persons per household). Taking a sample of approximately 4% of the statistical population of the study area the resultant sample size comes up to 638 which rounded up to 635 samples or respondents comprising heads of household. *Appendix D.1* in Volume 3: Appendices details out the methodology of the sampling frame adopted.

T6.51 shows the distribution of the sample size according to the population components in the study area. Accordingly, 31.5% or 200 samples and 47.2% or 300 samples were respectively gathered from among the fishing communities and the general public in the area; 15.7% or 100 samples and 5.5% or 35 samples were each directed to the local business operators and the beach users. From within the sampled fishermen group, 72.5% were the would be directly affected fishermen whilst the remaining 27.5% comprised fishermen from the outlaying areas of Kampung Pulau Betung and Kampung Teluk Tempoyak. F6.102 and F6.103 show some of the interviews conducted with the fishermen respondents.



F6.101 Settlements within the study area

T6.51 The population components surveyed by area and their respective sample size

Area	Fisherman	Public	Business Operator	Beach User
Kampung Teluk Tempoyak	25	-	-	-
Kampung Permatang Damar Laut	20	15	-	-
Kampung Sungai Batu	35	19	4	-
Kampung Teluk Kumbar	40	23	10	-
Kampung Gertak Sanggul	15	15	-	-
Kampung Bakar Kapur	10	-	-	-
Kampung Pulau Betung	20	-	-	-
Kampung Pasir Belanda	4	-	-	-
Kampung Gemuruh	2	-	-	-
Kampung Nelayan	9	-	-	-
Kampung Binjai	10	15	-	-
Kampung Permatang Tepi Laut	10	-	-	-
Kampung Permatang Damar Laut	-	15	-	-
Kampung Sungai Tiram	-	18	13	-
Kampung Matahari Jatuh	-	9	-	-
Kampung Perlis	-	8	-	-
Kampung Seronok	-	11	-	-
Taman Desaria Sri Merpati	-	19	-	-
Taman Tunas Damai	-	15	-	-
Taman Sri Puteri	-	16	-	-
Taman Sri Bayu	-	14	-	-
Kampung Tengah	-	3	-	-
Kampung Masjid	-	12	-	-
Kampung Bukit	-	16	-	-
Bukit Gedung	-	11	-	-
Kampung Manggis	-	13	-	-
Bayan Lepas	-	7	-	-
Taman Mutiara Perdana	-	7	-	-
Kampung Padang	-	9	-	-
Kampung Matahari Naik	-	7	-	-
Pangsapuri Taman Emas	-	11	-	-
Kampung Baruh Bayan Lepas	-	7	-	-
Pantai Teluk Bayu	-	-	-	12
Pesisir Pantai Sungai Batu	-	-	-	6
Pesisir Pantai Permatang Damar Laut	-	-	-	8
Pesisir Pantai Permatang Tepi Laut	-	-	-	4
Pesisir Pantai Gertak Sanggul	-	-	-	5
Bayan Lepas	-	-	8	-
Bayan Baru	-	-	4	-
Queensbay	-	-	7	-
Jalan Mahkamah	-	-	7	-
Bandar Baru Teluk Kumbar	-	-	9	-
Persiaran Rajawali	-	-	7	-
Jalan Kolam Air	-	-	13	-
Persiaran Bayan	-	-	10	-
Persiaran Relau	-	-	8	-
Total	**200**	**300**	**100**	**35**
Grand Total	**635**			

Source: Field survey, 2016

F6.102 Interviewing a respondent at Kampung Permatang Tepi Laut

F6.103 Interviewing a respondent at Kampung Gertak Sanggul

Altogether six FGDs were conducted involving a total of 126 participants. Nevertheless, in terms of category, more discussions with fishermen were successfully carried out compared to with the public due to two main reasons. First, the failure to raise an FGD group comprising the public in Kampung Sungai Batu. Second, an extra FGD with fishermen was convened as it was realised that the one in Sungai Batu which was meant for both fishermen of Sungai Batu and Teluk Kumbar ended up with the attendees being mostly from Sungai Batu and very few from Teluk Kumbar. Since Zone B i.e. fronting Island B is a major fishing area, the study team decided to hold another FGD for Teluk Kumbar. The combined effort was decided earlier on by the management in order to avoid repetitive discussions with similar target groups which could cause unnecessary social fatigue. T6.52 shows the distribution and details of the FGDs conducted and F6.104 and F6.105 show some snaps taken of the FGDs carried out.

T6.52 Details of the Focus Group Discussions (FGDs) conducted in the study area

Location	Date/Time	Venue	Category	Attendees
Kampung Sungai Batu	30/1/2016 10:00 am	Dewan JKKK Kampung Sungai Batu	Fishermen	13
Kampung Permatang Tepi Laut	5/2/2016 10:00 am	Dewan Unit Nelayan Kampung Permatang. Tepi Laut	Public	17
Kampung Permatang Tepi Laut	5/2/2016 5:00 pm	Dewan Unit Nelayan Kampung Permatang Tepi Laut	Fishermen	19
Kampung Teluk Kumbar	19/2/2016 5:20 pm	Dewan JKKK Kampung Teluk Kumbar	Fishermen	28
Kampung Gertak Sanggul	12/3/2016 10:00 am	Dewan Orang Ramai Kampung Gertak Sanggul	Public	9
Kampung Gertak Sanggul	12/3/2016 4:00 pm	Dewan Orang Ramai Kampung Gertak Sanggul	Fishermen	40

F6.104 FGD with the public at Kampung Permatang Tepi Laut

F6.105 FGD with the public at Kampung Gertak Sanggul

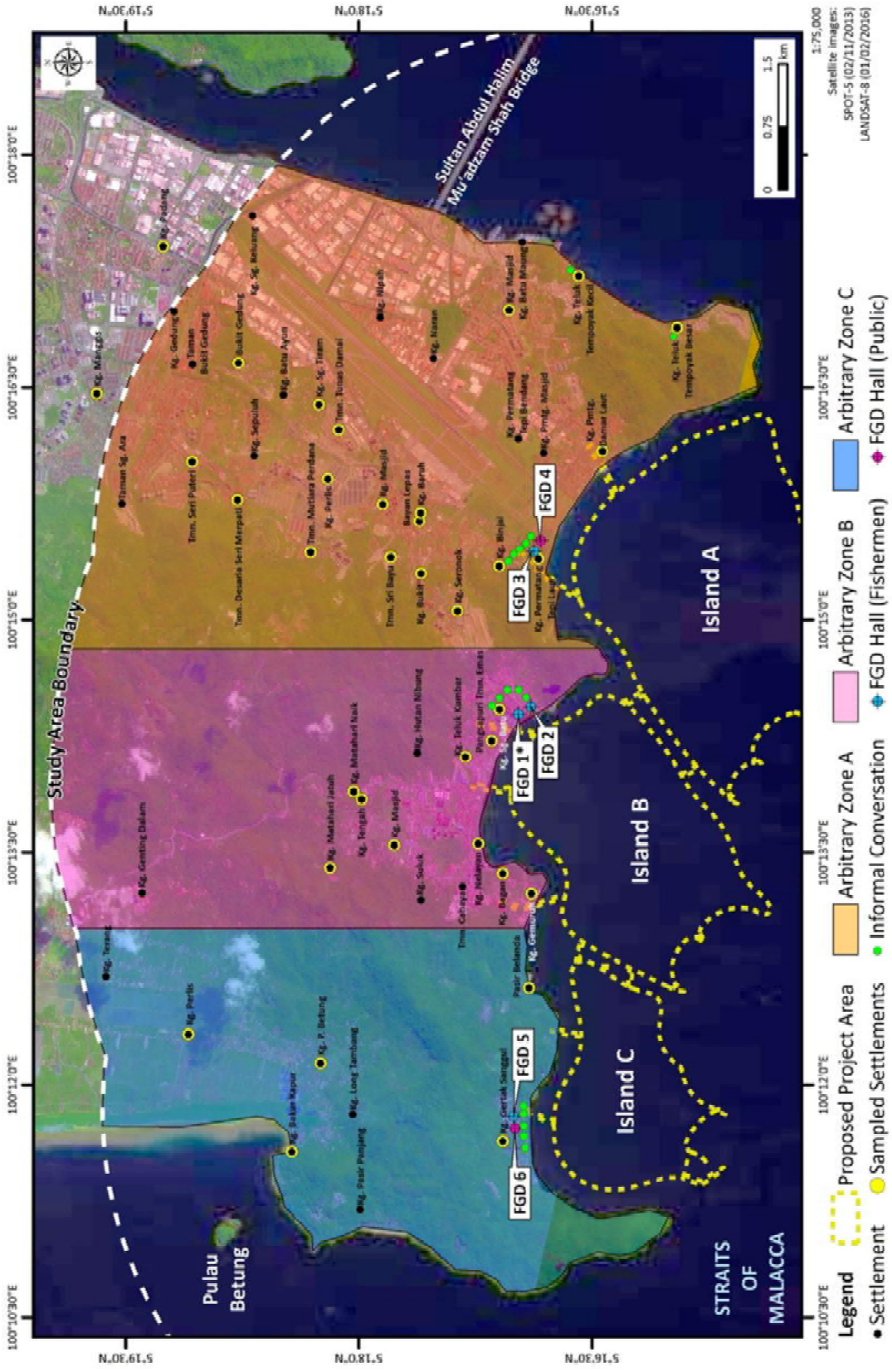
T6.53 shows the distribution of the informal conversations (F6.106 and F6.107) performed as well as the characteristics of the participants involved. As shown by the table, altogether 17 informal conversations were conducted involving a total of 50 participants with majority (82%) being Malay and the remaining 16% Chinese. Nevertheless, in terms of category they are almost equally divided with 54% being the public and the remaining 46% fishermen. F6.108 summarises the locations of the various types of data collected.

T6.53 Distribution of the informal conversations in the study area

Site	Ethnicity		Category	
	Malay	Chinese	Fishermen	Public
Kampung Sungai Batu (4 sessions)	14	0	6	8
Kampung Teluk Kumbar (3 sessions)	5	3	4	4
Kampung Nelayan, Teluk Kumbar (2 sessions)	5	2	3	4
Kampung Permatang Damar Laut (2 sessions)	5	0	2	3
Kampung Permatang Tepi Laut (1 session)	3	0	0	3
KampungTeluk Tempoyak Kecil (2 sessions)	4	0	2	2
Kampung Teluk Tempoyak Besar (1 session)	2	0	2	0
Kampung Gertak Sanggul (2 sessions)	3	4	4	3
Total	**41**	**9**	**23**	**27**
Grand Total	**50**		**50**	

F6.106 Informal conversation at Kampung Teluk Tempoyak Kecil

F6.107 Informal conversation at Kampung Gertak Sanggul



F6.108 Location of the various types of data collected

A Public Dialogue was also conducted to enable a face-to-face discussion between the stakeholders and the study team cum representative of the proponent, insofar as the Project details were concerned. The latter would enable the stakeholders to have a clearer perspective of what they were facing and for them to air any issues that matter to them. The feedbacks from such a forum would be of tremendous value to the study team in drawing conclusions and propagating recommendations of the study to be considered by all the parties concerned. Held at Lexis Suites, Teluk Kumbar, Pulau Pinang, the public dialogue was conducted on 17th December 2016 attracting some 835 locals and other interested individuals excluding another 25 reporters and journalists from both the electronic and print media. The list of attendees present at the dialogue is given in *Appendix C.2* in Volume 3: Appendices.

The detailed verbal exchanges that took place during the Q&A session, as well as the written comments collected at the end of the dialogue session are reported in *Appendix C.6* and *Appendix C.9* in Volume 3: Appendices respectively. F6.109 to F6.116 show the various moments taken at the public dialogue session.

F6.109 The opening of the Dialogue

F6.110 The Project brief by Chief Minister

F6.111 Facing the public

F6.112 The Q&A session: Voice from Seberang Perai

F6.113 Speaking for local fishermen

F6.114 Raising other local concerns

F6.115 Demonstration outside the venue

F6.116 Counter picketing by Project supporters

The above sources of information act as the primary data of the study. Information gleaned from published and unpublished reports and documents are the sources of secondary data for the report utilised to supplement and complement the self-generated data and information.

6.4.1.3 General Population Perspectives of the Study Area

6.4.1.3.1 General Population Growth and Distribution

The study area is located in the Southwest District of Pulau Pinang i.e. commiserating with its namesake, the southwestern most district of Pulau Pinang, fronting the Straits of Malacca. With a population of 197,131 persons in 2010 (2010 Census) it accounted for only 12.9% of the state population, making it the fourth largest district from the five districts in the State of Pulau Pinang in terms of population size, after the districts of Timur Laut (Northeast), Seberang Perai Tengah and Seberang Perai Utara with Seberang Perai Selatan being the fifth and the smallest.

The population of the study district in 2000 was 159,129 persons but had increased to 197,131 persons in 2010. This is an increase of 2.09% per annum between 2000 to 2010 but a decrease from the higher annual increase experienced previously from 1991 to 2000 which was 2.88%. A total of 58,344 living quarters was also recorded comprising 50,564 households with an average of 3.89 persons per household. The latter is found to be lower than the state average of 3.94 as well as even lower than the national average of 4.31 persons per household, meaning it has smaller households than the state or the national average.

The local authority areas/*mukims* in the Southwest District that are relevant to the study are Mukim I, Mukim J and Mukim 7 to Mukim 12 whose respective population size is given in T6.54. Although the average household size of the district was earlier found to be 3.89, the average household size of our samples was found to be larger amounting to 4.13 persons per household.