

3) Supplemental aerial observation

After the field survey, additional information on the coral reef and seagrass/seaweed beds was obtained through aerial observation.

4) Interviews

Interviews with local people and local government offices were conducted particularly for information on endangered marine wildlife (Dugongs and sea turtles).

5) Secondary data analysis

Necessary environmental data of the priority areas were collected for a basic understanding of the area.

5.3. Existing Condition of the Marine Environment of the Case Study Areas

1) Busuanga West

(1) Physical condition

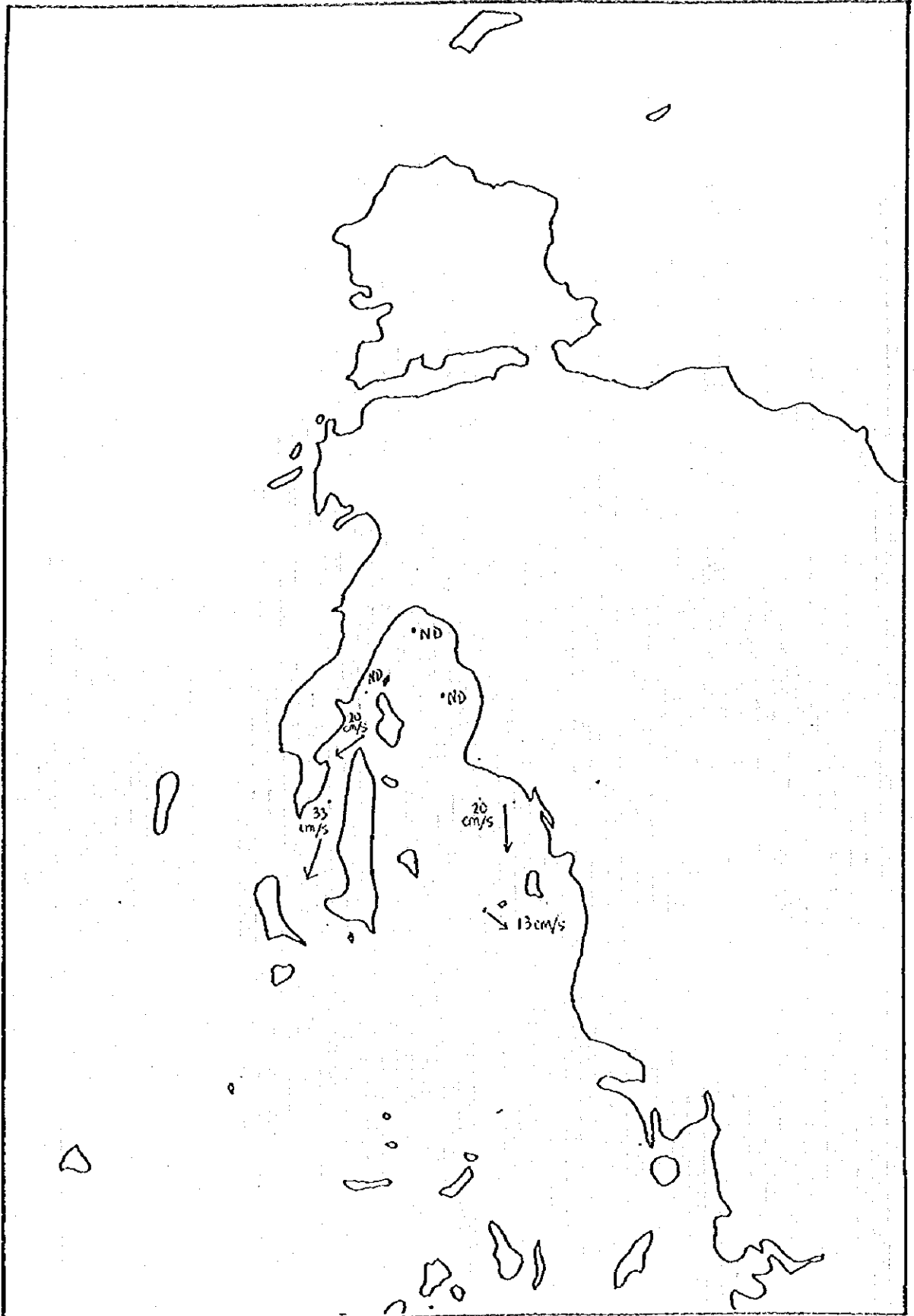
Tides in this area are mixed, dominant diurnal type. The tide range is 1.2 meters at maximum in the diurnal tide period. Waves are high in the open sea area especially in the southwest monsoon season, though a relatively calm condition is observed in Gutob Bay. Current measurement were conducted at several stations with a drogue (Figure 5-1). Current speed in southern Gutob Bay ranged from 13 to 33 cm / sec, while the inner northern part showed the open sea area to be 5 - 25cm/sec with a northeastward direction, though the actual field survey in the open sea area could not be conducted due to the rough sea condition.

(2) Chemical Condition

Water quality: Results of the water quality analysis showed no significant signs of eutrophication even in Gutob Bay (Figure 5-2) where pearl farming is on-going. Though water sampling could not be taken in the open sea area due to the rough sea condition, the seawater quality is believed to be excellent.

Bottom Sediment Quality: Results of analysis are shown in Figure 5-3. Sand is previously in Gutob Bay area, though muddy sea bottom was found off the Salvation Airship. This fact also suggests that the eutrophication is not severe in this area.

Figure 5-1 Current Speed and Direction in Gutob Bay



Source: Marine Survey, Study Team

Figure 5-1 Current Speed and Direction in Gutob Bay

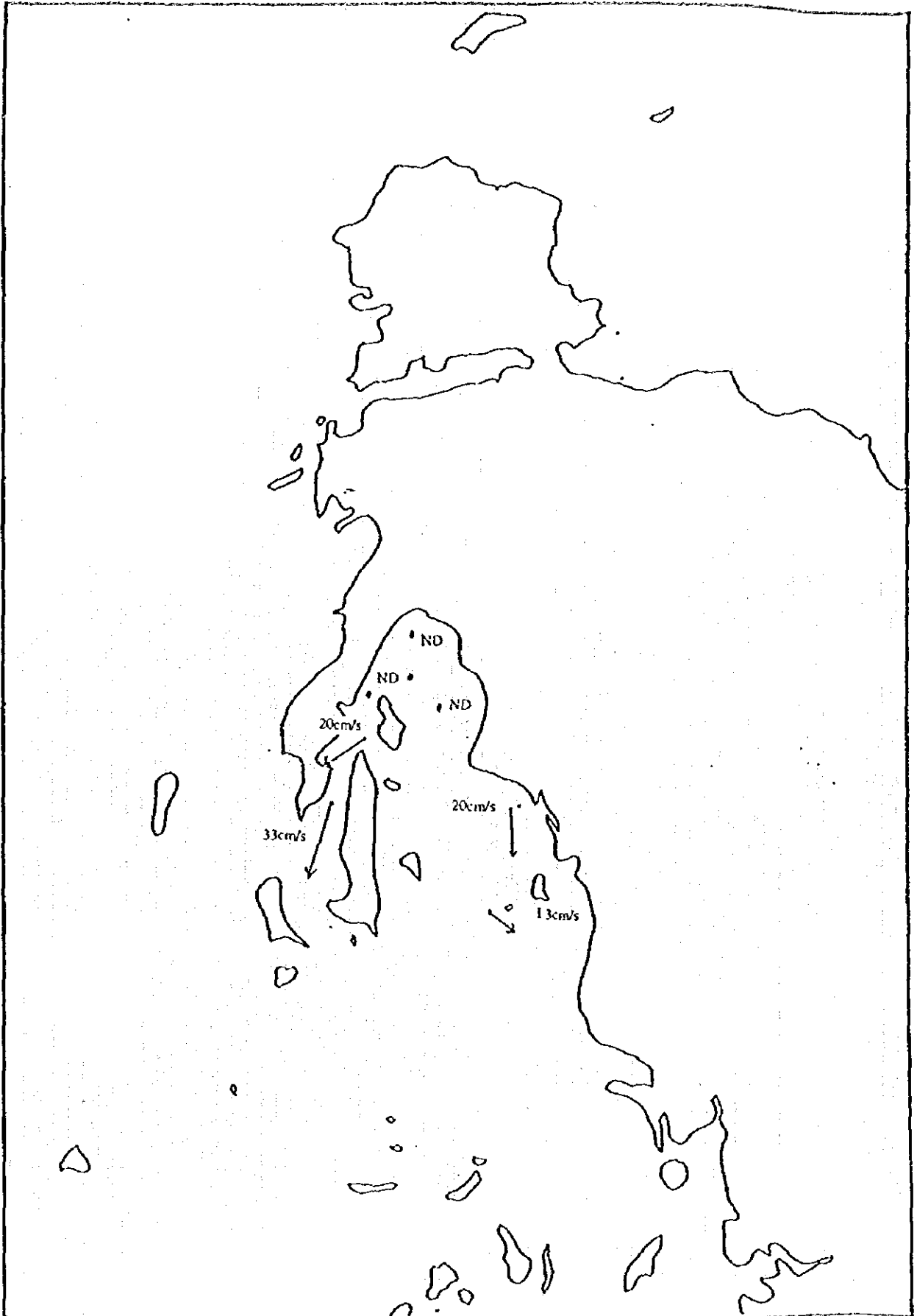
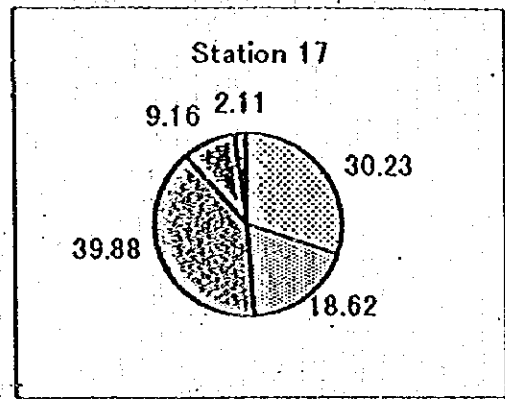
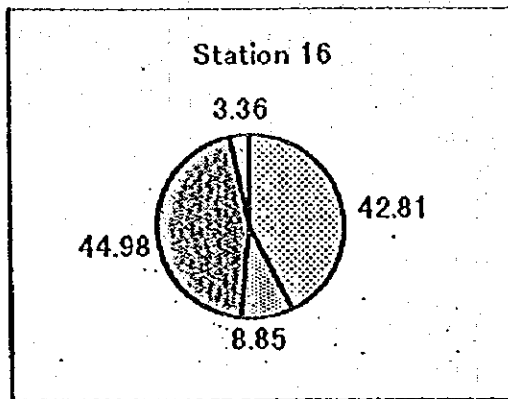
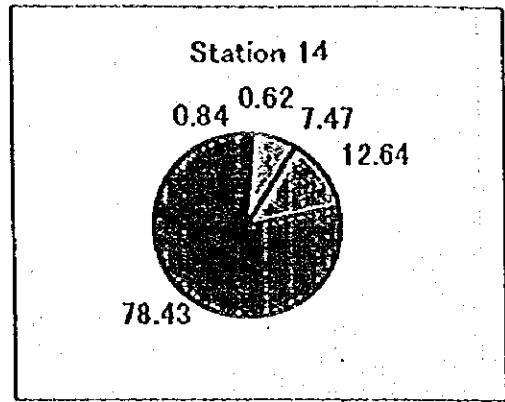
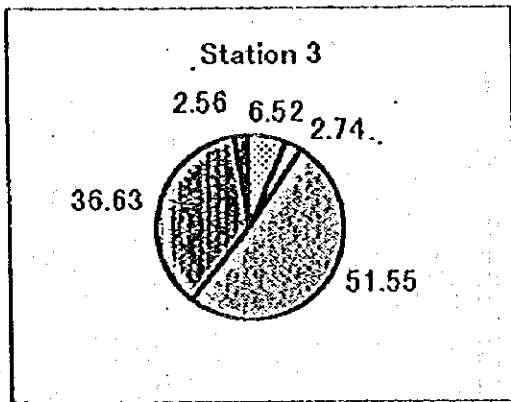


Figure 5-3 Grain Size Distribution of Sea Bottom Sediment in Busuanga West

	station 3	station 14	station 16	station 17
+10 Mesh	6.52	0.84	42.81	30.23
+18 Mesh	2.74	0.62	8.85	18.62
+70 Mesh	51.55	7.47	44.98	39.88
+200 Mesh	36.63	12.64	3.36	9.16
-200 Mesh	2.56	78.43	-	2.11



3) Biological Condition

(1) Coral reef

Horizontal distribution of coral reef and its quality, in terms of condition of healthiness, were evaluated through the aerial observation. Reef of higher rank was found abundant on the coast of Busuanga Peninsula facing the open sea. Findings from the diving survey showed a total of 54 genera present in this area (refer to Table 5-1). Detailed distribution of coral species obtained at a belt transect line is illustrated and summarized in Figure 5-4 and Table 5-2.

(2) Seagrass / seaweed

Horizontal distribution of seagrass and seaweed beds and its coverage were evaluated based on the aerial observation (Figure 5-3). This area has abundant seagrass and seaweed. Detailed distribution of seagrass/seaweed species is shown in Figure 5-4 and Table 5-2. A list of seagrass/seaweed recorded in this area is cited in Table 5-3.

(3) Reef-associated organisms

Findings from the diving survey are summarized in Table 5-4 for fish and Table 2.1.5 for macro - invertebrates. As for fish, 120 species were encountered in the Busuanga area. Species number and diversity was very low. For invertebrates, sponges, soft corals, clams, echinoderms and ascidians were main component.

(4) Mangrove

Though the detailed field observation was not conducted, the aerial observation showed that the quantity and quality are poor in general, except for in the head of Illutuk Bay.

(5) Endangered marine wildlife

It was pointed out by local people that Dugongs and sea turtles could often be found in this area. Abundant seagrass beds, food for Dugong and sea turtles, attract them to the area. In addition, this area provides various habitats for them to rest and to hide when the sea condition is severe. Hawksbill sea turtles are also supposed to occur in this area, though nesting grounds could not be identified through the interviews.

Table 5-1 Coral Generic Composition in Busuanga West

Family	Genus	Colony Form	Line	Busuanga					
				Sta. 1	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9*
Pocilloporidae	<i>Pocillopora</i>		r	f		f	f		
	<i>Seriatopora</i>		r	f	f	c	f	f	
	<i>Stylophora</i>				f	r	r	r	
Acroporidae	<i>Montipora</i>	encrusting	r	c		c		c	
	<i>Montipora</i>	arborescent	r	r	r	c	r	r	
	<i>Anacropora</i>		r	ccM			ccM	c	
	<i>Acropora (Isopora)</i>		f	f	r	r	r		
	<i>Acropora</i>	tabular	r			r	r	r	
	<i>Acropora</i>	arborescent	c	ccM		c	f	c	
	<i>Acropora</i>	corymbose	r	r	r		r	r	
	<i>Acropora</i>	caespitose	r	f		c		r	
	<i>Acropora</i>	digitate		r	r	r			
	<i>Acropora</i>	bottle-brush	c	ccL	c		f	f	
	<i>Astreopora</i>		r	r	f	cl		c	
Poritidae	<i>Porites</i>	massive	ccM	ccM	cl	c	cc	ccL	
	<i>Porites</i>	arborescent	c	r		r	r	rM	
	<i>Goniopora</i>		r	f	f	f	r	r	
	<i>Alveopora</i>		r						
Siderastreidae	<i>Psammocora</i>		f	r		r	r		
Agariciidae	<i>Pavona</i>		f	f	f	r	f	r	
	<i>Leptoseris</i>			f			f	fl	
	<i>Gardineroseris</i>		r	r		r		r	
	<i>Coeloseris</i>		r	r	r	r		r	
	<i>Pachyseris</i>		r	fl		r	r	rl	
Fungiidae	<i>Dioseris</i>					r		r	
	<i>Heliofungia</i>		r	f	f	f	c	f	
	<i>Fungia</i>		f	f	f	f	c	f	
	<i>Herpolitha</i>						r		

Table 5-1 cont.

Family	Genus	Colony Form	Busuanga						
			Line 1	Sta. 1	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9*
Fungiidae	<i>Polyphyllia</i>		r						
	<i>Halomitra</i>					r			
	<i>Sondalolitha</i>		f		f	r	r		
	<i>Lithophyllon</i>					r			
	<i>Pedabocia</i>		r						
Oculinidae	<i>Galaxea</i>		f	cl	c	fl	c	r	
	<i>Aerelia</i>		r						
Pectiniidae	<i>Echinophyllia</i>		r			fl	fl	r	
	<i>Oxypora</i>					r			
	<i>Mycedum</i>					r			
	<i>Pectinia</i>				f	fl	r	r	
Mussidae	<i>Blastomussa</i>					r			
	<i>Cynarina</i>								
	<i>Acanthostrea</i>								
	<i>Lobophyllia</i>		fl	fl		r	f	rl	
	<i>Symphyllia</i>		f	f	rl	f		r	
Merulinidae	<i>Hydnophora</i>		f	ckf		c		rl	
	<i>Merulina</i>		fl	c	f	r	fl	r	
	<i>Scopophyllia</i>							r	
Faviidae	<i>Caulostrea</i>								
	<i>Favia</i>		c	ccL	fl	c	f	c	
	<i>Barabattota</i>								
	<i>Favites</i>		c	ccL	cl	c	c	e	
	<i>Gonastrea</i>		cl	f	f	c	fl	e	
	<i>Platygyra</i>		f	f		c	f	e	
	<i>Leptoria</i>		r	r		f		r	
	<i>Oxlophyllia</i>								
<i>Montastrea</i>		r	r		r	r			

Table 5-1 cont.

Family	Genus	Colony Form	Busuanga							
			Line 1	Sta. 1	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9*	
Faviidae	<i>Oulastrea</i>					r				
	<i>Plerostrea</i>					r				
	<i>Diploastrea</i>				r		rL			
	<i>Leptostrea</i>		r	f	r	f	r	r		
	<i>Cyphastrea</i>		f	c	c	f	c	f		
	<i>Echinopora</i>		M	cM		f		M		
Trachyphylliidae	<i>Trachyphyllia</i>									
Caryophylliidae	<i>Euphyllia</i>			r	r	r	r			
	<i>Pterogyra</i>							r		
	<i>Physogyra</i>			r				r		
Dendrophylliidae	<i>Turbinoria</i>			r		r	r			
Tubiporidae	<i>Tubipora</i>									
Helioporidae	<i>Heliopora</i>						r	r	r	
	<i>Heliopora</i>									
Milleporidae	<i>Millepora</i>	encrusting					r			
	<i>Millepora</i>	arborescent			rL		f	f	rL	
Stylasteridae	<i>Stylaster</i>							r		
Total			38	46	25	49	42	40	*	
			64							

Source: Marine Survey, Study Team

Legend: cc: abundant; c: common; f: few; r: rare

L: colony diameter: more than 1 meter; M: microatoll or large monospecific stand.

Figure S-4 Percentage of Dominant Coral Genera, Seagrass, Seaweed, Substrate & Extent of Siltation in Belt Transect 1, Busuanga

Date: 13 Sep. 1996

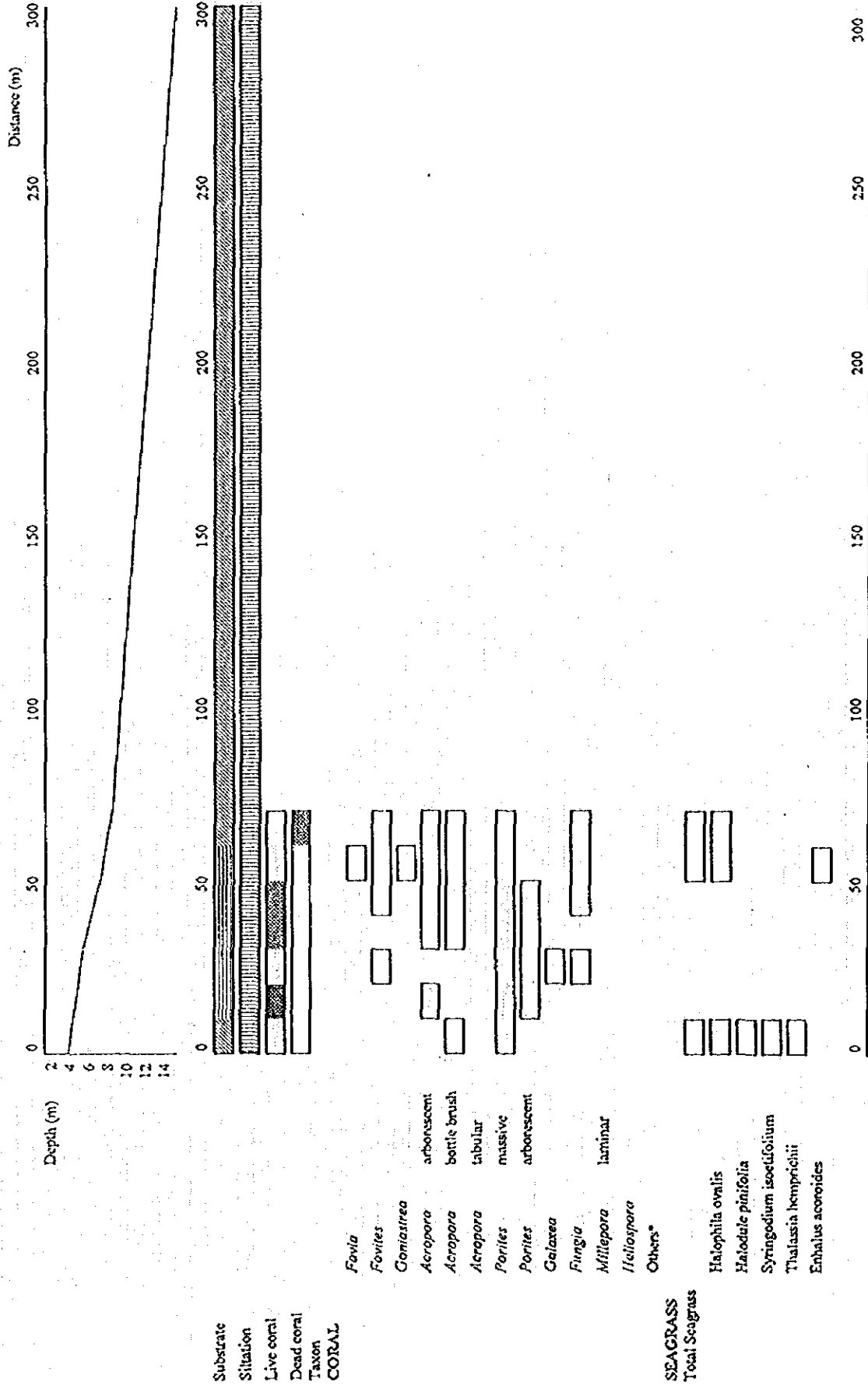
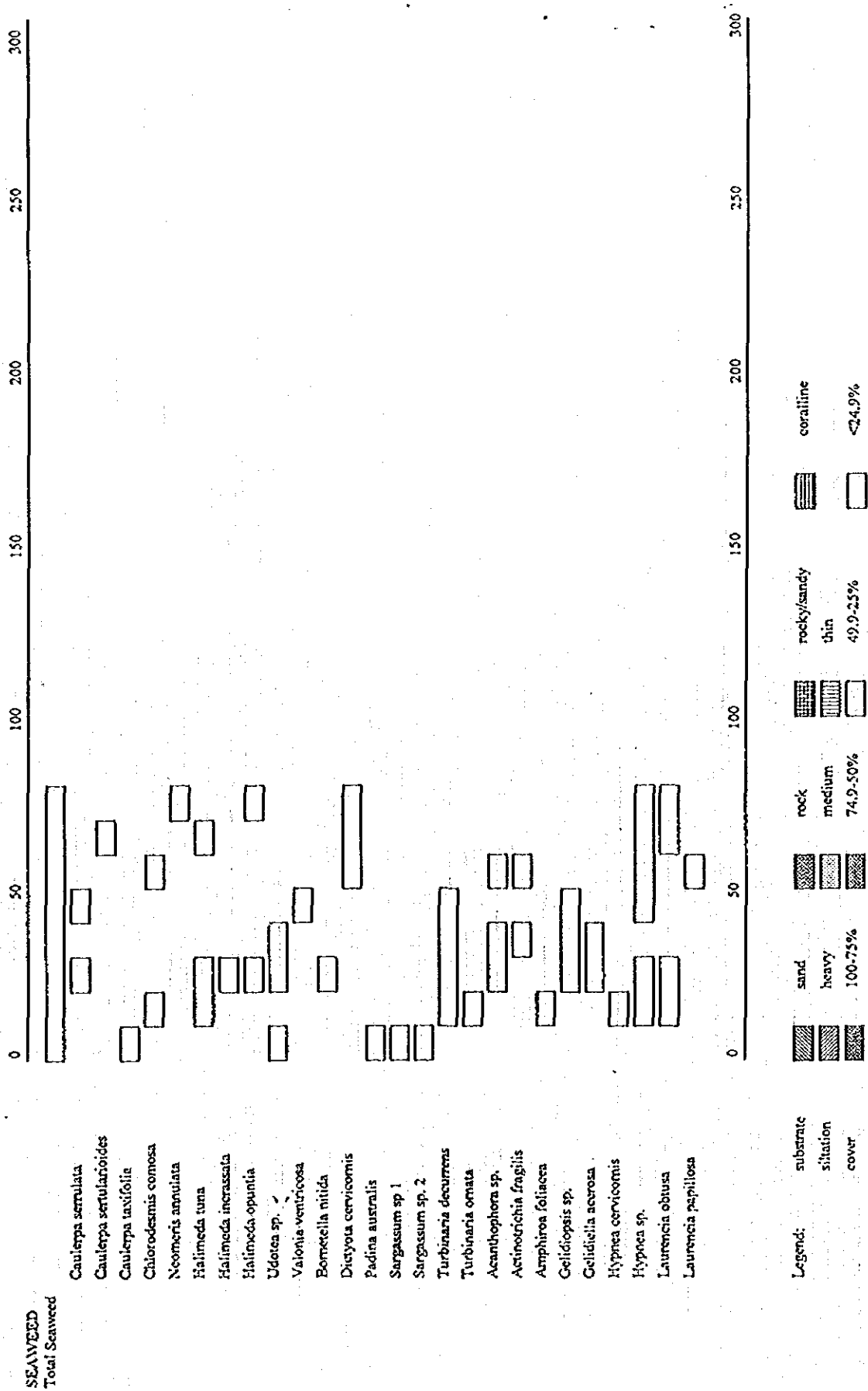


Figure 5-4 cont.



Source: Marine Survey, Study Team

Table 5-2 Percentage Cover of Coral Genera, Seagrass and Seaweed at Belt Transect Line 1, Busuanga, Northern Palawan.

Distance (m)	0	50	100	150	200	250	300
<i>Lobophyllia</i>		*					
<i>Symphylia</i>		*					
<i>Ilyinophora</i>	*						
<i>Oxypora</i>	*						
<i>Mixedium</i>		*					
<i>Pectinia</i>			*				
<i>Blastomussa</i>		*					
<i>Cynarina</i>	*						
<i>Acanthastrea</i>	*						
<i>Lobophyllia</i>		*	*				
<i>Symphylia</i>	*		*				
<i>Ilyinophora</i>	*	*					
<i>Merulina</i>	*	*					
<i>Platygyra</i>	*	*					
<i>Leptoria</i>		*					
<i>Montastrea</i>	*	*					
<i>Lepastrea</i>	*	*					
<i>Cyphastrea</i>	*	*					
<i>Echinopora</i>	*	*					
Seagrass							
Total Seagrass Cover (%)	10						
<i>Halophila ovalis</i>	*	*					
<i>Halodule pinifolia</i>	*	*					
<i>Syringodium isoetifolium</i>	*	*					
<i>Thalassia hemprichii</i>	*	*					
<i>Enhalus acoroides</i>	*	*					
Seaweed							
Total Seaweed Cover (%)	10	10	10	10	10	10	10
Chlorophyta							
<i>Caulerpa serrulata</i>		*					
<i>Caulerpa sertularioides</i>		*					
<i>Caulerpa racifolia</i>	*	*					
<i>Chlorodesmis comosa</i>	*	*					

Table S-2 cont.

	Distance (m)															
	0	10	20	30	40	50	60	70	80	90	100	150	200	250	300	
Live coral cover (%)	40	30	20	10	10	10	10	10	10	10	10					
Dead coral cover (%)	10	10	10	10	10	10	10	10	10	10	10					
Taxon																
Coral																
Favia						10										
Favites																
Goniastrea																
Acropora arborescent		30	10	20	10											
Acropora bottle brush			10	10												
Acropora tabular																
Porites massive	40	40	20	30	30	20	20									
Porites arborescent		10	10													
Galaxea																
Fungia																
Millepora laminar																
Helopora																
Others (uncommon)																
Pocillopora																
Seriopora																
Montipora																
Anacropora																
Isopora																
Asreopora																
Goniopora																
Aneopora																
Psammodora																
Pavona																
Gardineroseris																
Coeloseris																
Pachyseris																
Heliofungia																
Acrotelia																

Table 5-2 cont.

Distance (m)	0	50	100	150	200	250	300
<i>Neomeris annulata</i>							
<i>Halimeda incrassata</i>		*					
<i>Halimeda opuntia</i>		*					
<i>Halimeda luna</i>		*					
<i>Ulloea</i> sp.		*					
<i>Yalonia ventricosa</i>		*					
<i>Bornetella nitida</i>		*					
Phaeophyta							
<i>Colpomenia striatosa</i>							
<i>Dichyota cervicornis</i>		*					
<i>Padina australis</i>		*					
<i>Sargassum</i> sp. 1		*					
<i>Turbinaria decurrens</i>		*					
<i>Turbinaria ornata</i>		*					
Rhodophyta							
<i>Acunthophora</i> sp.		*					
<i>Actinorhynchia fragilis</i>		*					
<i>Amphiroa foliacea</i>		*					
<i>Ceclioptis</i> sp.		*					
<i>Ceclidella acerosa</i>		*					
<i>Hypnea cervicornis</i>		*					
<i>Hypnea</i> sp.		*					
<i>Laurencia obtusa</i>		*					
<i>Laurencia papillosa</i>		*					

Note: * <10%

Table 5-3 List of Seagrass and Seaweed Recorded in Busuanga, Northern Palawan

Division	Family	Species	Line 1	St. 1	St. 5	St. 6	St. 7	St. 8	St. 9	St. 10
Seagrass										
SPERMATOPHYTA	Hydrocharitaceae	<i>Enhalus acoroides</i>			f	r				r
	Hydrocharitaceae	<i>Halophila ovalis</i>	r							r
	Hydrocharitaceae	<i>Syringodium isoanfolium</i>	r							r
	Hydrocharitaceae	<i>Thalassia hemprichii</i>	f							
	Potamogetonaceae	<i>Cymodocea rotundata</i>				r				
	Potamogetonaceae	<i>Halodule pinifolia</i>	r							
Seaweed										
CHLOROPHYTA (Green Algae)	Anadyomenaceae	<i>Anadyomene sp.</i>				r	r			r
	Anadyomenaceae	<i>Microdictyon sp.</i>				r				
	Caulerpaceae	<i>Caulerpa peltata</i>								r
	Caulerpaceae	<i>Caulerpa tomentos</i>								r
	Caulerpaceae	<i>Caulerpa serrulata</i>	r	r						
	Caulerpaceae	<i>Caulerpa sertularioides</i>	r	r						r
	Caulerpaceae	<i>Caulerpa taxifolia</i>	r							
	Dasycladaceae	<i>Bornetella nitida</i>	r							
	Dasycladaceae	<i>Neomeris annulata</i>	r	r		r	r			r
	Halimedaceae	<i>Halimeda discoidea</i>		r		r	r			
	Halimedaceae	<i>Halimeda incrassata</i>	r							r
	Halimedaceae	<i>Halimeda maculosa</i>				r	r			r
	Halimedaceae	<i>Halimeda opuntia</i>	r	r			r	r		r
	Halimedaceae	<i>Halimeda tuna</i>	r	r			r	r		
	Halimedaceae	<i>Halimeda velasquezii</i>					r			r
	Udoteaceae	<i>Chlorodesmis comosa</i>	r	r				r		r
	Udoteaceae	<i>Udotea sp.</i>	r				r	r		r
	Valoniaceae	<i>Dicyosphaeria cavernosa</i>	r	r				r		r
	Valoniaceae	<i>Valonia ventricosa</i>	r							
PHAEOPHYTA (Brown Algae)	Dictyotaceae	<i>Dictyota cervicornis</i>	r							
	Dictyotaceae	<i>Dictyota dichotoma</i>				r	r	r		r
	Dictyotaceae	<i>Lobophora variegata</i>								r
	Dictyotaceae	<i>Podina australis</i>	r	r		r	r	r		r
	Dictyotaceae	<i>Podina japonica</i>								r
	Dictyotaceae	<i>Podina minor</i>		r						r
	Sargassaceae	<i>Sargassum sp. 2</i>	r			r				r
	Sargassaceae	<i>Turbinaria decurrens</i>	r							
Sargassaceae	<i>Turbinaria ornata</i>	r								
RHODOPHYTA (Red Algae)	Corallinaceae	<i>Amphiroa foliacea</i>	r	r			r	r		
	Cryptonemiaceae	<i>Holymentia durvilloei</i>			r					
	Cryptonemiaceae	<i>Laurencia obtusa</i>	r					r		r
	Cryptonemiaceae	<i>Laurencia papillosa</i>	r							r
	Galaxauraceae	<i>Galaxaura oblongata</i>						r		
	Gelidiaceae	<i>Gelidiella acerosa</i>	r				r			
	Gracilariaceae	<i>Ceratodictyon spongiosum</i>								r
	Gracilariaceae	<i>Gelidiopsis intricata</i>	r	r			r	r		r
	Gracilariaceae	<i>Gracilaria solitaria</i>					r			r

Table 5-3 cont.

Division	Family	Species	Line 1	St.1	St.5	St.6	St.7	St.8*	St.9*	St.10	
	Gracilariaceae	<i>Gracilaria sp. 1</i>			r					r	
	Hypneaceae	<i>Hypnea cervicornis</i>	f	f							
	Hypneaceae	<i>Hypnea esperi</i>	f		r					f	
	Hypneaceae	<i>Hypnea sp.</i>				f	f			f	
	Nemastomaceae	<i>Titanophora sp.</i>		r							
	Peyssonneliaceae	<i>Peyssonnelia sp.</i>					r			r	
	Rhodomelaceae	<i>Acanthophora sp.</i>	r								
	Rhodomelaceae	<i>Actinotrichia fragilis</i>	r								
CYANOPHYTA (Blue Green Algae)	Oscillatoriaceae	<i>Lyngbya sp.</i>		r		r	r			r	
			29	16	8	19	17	*	*	29	
			52								

Source: Marine Survey, Study Team

cc = abundant; c = common; f = few; r = rare

* no data gathered due to very poor visibility.

Table 5-4 Reef-associated Fish Species Recorded at Survey Areas, Busuanga West

Core Group	Family	Taxonomy	Busuanga							
			Line1	Stn1	Stn5	Stn6	Stn7	Stn8	Stn9*	Stn10
Target	Serranidae	<i>Cephalopholis boenak</i>				r	r			
		<i>Diplopteron bifasciatum</i>								
		<i>Epinephelus fasciatus</i>								
		<i>Epinephelus merca</i>			r					
		<i>Plectropomus leopardus</i>								
	Siganidae	<i>Siganus argenteus</i>								
		<i>Siganus spinus</i>								
		<i>Siganus virgatus</i>			r					
		<i>Siganus vulpinus</i>			r				r	
		<i>Caesio caeruleaurea</i>							c	
	Caesionidae	<i>Caesio cuning</i>			c	cc	cc	cc		
		<i>Pterocaesio diogramma</i>								
		<i>Pterocaesio tile</i>								
		<i>Pterocaesio trilineata</i>							c	
		<i>Atule mate</i>							f	
Carangidae		<i>Plectorhinchus diogramma</i>								
Haemulidae		<i>Plectorhinchus plectus</i>								
	Lethrinidae	<i>Gnathodentex aurolineatus</i>								
<i>Lethrinus harak</i>										
<i>Lethrinus olivaceus</i>										
<i>Lethrinus sp. 1</i>										
<i>Lethrinus sp. 2</i>										
Lutjanidae	<i>Lutjanus carponotatus</i>									
	<i>Lutjanus decussatus</i>			r						
	<i>Lutjanus fulviflamma</i>									
	<i>Lutjanus fulvus</i>									
	<i>Lutjanus rivulotus</i>									
	<i>Lutjanus timorensis</i>									
Acanthuridae	<i>Lutjanus vitta</i>				cc					
	<i>Acanthurus grammoptilus</i>									
	<i>Acanthurus lineatus</i>									
	<i>Acanthurus olivaceus</i>							r		
	<i>Acanthurus triostegus</i>									
		<i>Ctenochoetus binotatus</i>		f						

Table 5-4 cont.

Core Group	Family	Taxonomy	Busuanga								
			Line1	Stn1	Stn5	Stn6	Stn7	Stn8	Stn9 ^a	Stn10	
Major	Labridae	<i>Ctenochaetus striatus</i>	f								
		<i>Naso annulatus</i>									
		<i>Naso lituratus</i>									
		<i>Zebrasoma veliferum</i>	f				r				
		<i>Anampses caeruleopunctatus</i>									
		<i>Bodianus loxozonus</i>									
		<i>Bodianus mesothorax</i>									
		<i>Cheilinus celebecus</i>					r				
		<i>Cheilinus chlorourus</i>	r				r				
		<i>Cheilinus trilobatus</i>									
		<i>Cheilinus unifasciatus</i>	r	r				r			
		<i>Cheilio inermis</i>									
		<i>Choerodon anchorago</i>	r								
		<i>Coris gaimard</i>									
		<i>Coris schroederi</i>	r				r				
		<i>Diproctacanthus xanthurus</i>	r				f	f	r		
		<i>Epibulus insidiator</i>		r				r			
		<i>Gomphosus varius</i>									
		<i>Holichoeres chloropterus</i>	r								r
		<i>Holichoeres hortulanus</i>									r
		<i>Holichoeres marginatus</i>		r					r		
		<i>Holichoeres melanurus</i>	f				r				r
		<i>Holichoeres nebulosus</i>									
		<i>Holichoeres prosopion</i>									
		<i>Hemigymnus fasciatus</i>		r							
		<i>Hemigymnus melopterus</i>	f				f				
		<i>Lobrichthys unilineatus</i>	r	r					r		
		<i>Labroides dimidiatus</i>	r	r				r			
		<i>Macropharyngodon meleagris</i>									
		<i>Pterogogus cryptus</i>									
		<i>Stethojulis bandanensis</i>									
		<i>Stethojulis strigiventer</i>									
		<i>Stethojulis trilineata</i>	r								
<i>Thalassoma hardwicke</i>	r					r					

Table S-4 cont.

Core Group	Family	Taxonomy	Busuanga							
			Line1	Stn1	Stn5	Stn6	Stn7	Stn8	Stn9*	Stn10
		<i>Thalassoma lunare</i>		f		c				
	Mullidae	<i>Parupeneus barberinoides</i>								f
		<i>Parupeneus barberinus</i>	r			f				r
		<i>Parupeneus bifasciatus</i>								
		<i>Parupeneus cyclostomus</i>								
		<i>Parupeneus indicus</i>								
		<i>Parupeneus multifasciatus</i>		r		r				
		<i>Parupeneus pleurostigma</i>								
		<i>Mulloides vanicolensis</i>								
		<i>Upeneus tragula</i>								
	Nemipteridae	<i>Monotaxis grandoculis</i>					r			
		<i>Pentapodus caninus</i>								
		<i>Pentapodus nemurus</i>					f			f
		<i>Scolopsis bilineatus</i>	r							f
		<i>Scolopsis ciliatus</i>				c				
		<i>Scolopsis lineatus</i>	r							
		<i>Scolopsis margaritifer</i>	f		r	f				
		<i>Scolopsis monogramma</i>			r					
		<i>Scolopsis sp. 1</i>	r							
	Pomacanthidae	<i>Chaetodontoplus mesoleucus</i>		r		f		r		
		<i>Pomacanthus semicirculatus</i>								
		<i>Pomacanthus sexstriatus</i>				r				
		<i>Pygoplites diocanthus</i>								
	Pomacentridae	<i>Abudefduf saxatilis</i>	f							
		<i>Abudefduf sexfasciatus</i>	c							
		<i>Abudefduf troscholti</i>								
		<i>Acanthochromis polyacanthus</i>	cc	c		cc	f			
		<i>Amblyglyphidodon curacao</i>	cc	cc		cc				
		<i>Amblyglyphidodon leucogaster</i>					f			
		<i>Amblyglyphidodon ternatensis</i>	c	f			f			
		<i>Amblypomacentrus breviceps</i>			c					
		<i>Amphiprion akallopsis</i>								
		<i>Amphiprion clarkii</i>						r		
		<i>Amphiprion frenatus</i>				r	r			

Table 5-4 cont.

Core Group	Family	Taxonomy	Busuanga							
			Line1	Sta1	Sta5	Sta6	Sta7	Sta8	Sta9*	Sta10
		<i>Chromis amboinensis</i>		cc		cc		cc		
		<i>Chromis sp. 1</i>				f				
		<i>Chromis viridis</i>		cc		cc		cc		
		<i>Chromis weberi</i>								
		<i>Chromis xanthura</i>								
		<i>Chrysiptera poroseina</i>		c					c	
		<i>Chrysiptera springeri</i>	f					f		
		<i>Dascyllus oruanus</i>	f							
		<i>Dascyllus melanurus</i>	f							
		<i>Dascyllus reticulatus</i>				f		f		
		<i>Dascyllus trimaculatus</i>								
		<i>Dischistodus melanotus</i>	f			f				
		<i>Dischistodus perspicillatus</i>	f	f	f					f
		<i>Dischistodus prosopotaenia</i>	f	f	f					f
		<i>Neoglyphidodon melas</i>	f	f						
		<i>Neoglyphidodon nigroris</i>		f		f		f	f	
		<i>Neoglyphidodon oxyodon</i>								
		<i>Neopomacentrus anobatoides</i>		c		cc			cc	
		<i>Neopomacentrus azysron</i>								
		<i>Plectroglyphidodon dickii</i>						f		
		<i>Plectroglyphidodon lacrymatus</i>	f			f		f		
		<i>Pomacentrus alexanderae</i>	cc	cc		cc		cc		
		<i>Pomacentrus amboinensis</i>	c		f	c				f
		<i>Pomacentrus oquillus</i>						f		
		<i>Pomacentrus bankanensis</i>								
		<i>Pomacentrus butroghi</i>		f				f		
		<i>Pomacentrus chrysurus</i>	f							
		<i>Pomacentrus coelestis</i>								
		<i>Pomacentrus graminorhynchus</i>						f		
		<i>Pomacentrus lepidogenys</i>				f		f		
		<i>Pomacentrus moluccensis</i>	f	f		f		cc	f	
		<i>Pomacentrus smithi</i>		f		cc		c	f	
		<i>Pomacentrus sp. 1</i>								
		<i>Pomacentrus sp. 2</i>						f		

Table 5-4 cont.

Core Group	Family	Taxonomy	Busuanga							
			Line1	Sta1	Sta5	Sta6	Sta7	Sta8	Sta9*	Sta10
		<i>Pomacentrus sp. 3</i>								
		<i>Pomacentrus sp. 4</i>	f	r				f		
		<i>Pomacentrus sp. 5</i>		r						
		<i>Pomacentrus stigma</i>								
		<i>Premnas biaculeatus</i>								
		<i>Stegastes obreptus</i>								
		<i>Stegastes sp. 1</i>						r		
	Pseudochromidae	<i>Labrocinus melanotaenia</i>		r						
		<i>Ogilbyina sp.</i>					r			
	Scaridae	<i>Cetoscarus bicolor</i>					r			
		<i>Hipposcarus longiceps</i>	f							
		<i>Scarus bleekeri</i>	f				f			
		<i>Scarus dimidiatus</i>	f							
		<i>Scarus flavipectoralis</i>					f			
		<i>Scarus frenatus</i>	r							
		<i>Scarus hyslepterus</i>								
		<i>Scarus niger</i>								
		<i>Scarus schlegeli</i>		r						
		<i>Scarus sordidus</i>								
		<i>Scarus sp. 1</i>								
		<i>Scarus sp. 2</i>								f
	Holocentridae	<i>Myripristis kuntee</i>								
		<i>Neoniphon sammira</i>								
		<i>Sargocentron rubrum</i>								
	Sphyraenidae	<i>Sphyraena flavicauda</i>								
Indicator	Chaetodontidae	<i>Chaetodon auriga</i>								
		<i>Chaetodon baronessa</i>								
		<i>Chaetodon benetti</i>					r			
		<i>Chaetodon citrinellus</i>								
		<i>Chaetodon kleinii</i>								
		<i>Chaetodon lineolatus</i>								
		<i>Chaetodon lunula</i>								
		<i>Chaetodon melannotus</i>		r					r	
		<i>Chaetodon octofasciatus</i>	f	r		r		f	r	

Table 5-4 cont.

Core Group	Family	Taxonomy	Busuanga							
			Line1	Stn1	Stn5	Stn6	Stn7	Stn8	Stn9*	Stn10
		<i>Chaetodon ornatissimus</i>								
		<i>Chaetodon trifasciatus</i>		f	r			r		
		<i>Chaetodon ulietensis</i>		r						
		<i>Chaetodon unimaculatus</i>								
		<i>Chaetodon vagabundus</i>								
		<i>Chaetodon xanthurus</i>								
		<i>Chelmon rostratus</i>		r				r		
		<i>Coradion chryzonus</i>	r							
		<i>Hentochus chryzostomus</i>	r					r		
Others	Apogonidae	<i>Apogon argustatus</i>	f					c		
		<i>Apogon compressus</i>				f				
		<i>Apogon sp. 1</i>						c		
		<i>Apogon sp. 2</i>								
		<i>Apogon sp. 3</i>								
		<i>Apogon sp. 4</i>		f		cc				
		<i>Apogon sp. 5</i>						c		
		<i>Archamia zosterophora</i>						cc		
		<i>Cheilodipterus macrodon</i>					c			
		<i>Cheilodipterus subulatus</i>					c			
	Tetraodontidae	<i>Arothron hispidus</i>								
		<i>Arothron nigropunctatus</i>	r	r						
		<i>Arothron stellatus</i>	r							
		<i>Conthigaster bennetti</i>								
		<i>Conthigaster valentini</i>	r							
	Monacanthidae	<i>Cantherines pardalis</i>								
		<i>Cantherines sp. 1</i>								
		<i>Parolutes prionurus</i>								
		<i>Paramonocentrus japonicus</i>								
	Balistidae	<i>Rhinecanthus oculatus</i>								
		<i>Rhinecanthus verrucosus</i>				r				
		<i>Sufflamen chrysopieris</i>								
	Aulostomidae	<i>Aulostomus chinensis</i>					r			
	Blenniidae	<i>Meiacanthus sp.</i>								f
	Centriscidae	<i>Aeoliscus strigatus</i>								
	Centropomidae	<i>Psainmoperca sp.</i>								
	Ephippidae	<i>Platax orbicularis</i>		f						
		<i>Platax pinnatus</i>								
	Fistulariidae	<i>Fistularia commersonii</i>								
	Microdesmidae	<i>Ptereleotris evides</i>								
	Gobiidae	<i>Istigobius regilius</i>								f
		<i>Amblygobius decussatus</i>				r				r
	Kyphosidae	<i>Kyphosus cinerascens</i>								
	Opistognathidae	<i>Opistognathus sp.</i>								
	Penipheridae	<i>Penipheris ovalensis</i>								
	Pinguipedidae	<i>Parapercis hexoptalma</i>								
	Plotosidae	<i>Plotosus lineatus</i>	cc	cc						
	Scorpaenidae	<i>Dendrochirus zebra</i>								
	Zanclidae	<i>Zanclus cornutus</i>	f			f	f			
			54	39	12	45	40	14	*	14

120

Source: Marine Survey, Study Team

cc = abundant; c = common; f = few; r = rare

* under heavy siltation, survey not possible.

Table 5-5 Associated Macro-invertebrates Recorded in Busuanga West

Division	Family	Genus	Busuanga								
			L1	S1	S5	S6	S7	S8	S9*	S10	
Porifera	Aplysinidae	<i>Aplysina</i>									
	Callyspongiidae	<i>Collyspongia</i>		r	r	r					
	Chalinidae	<i>Haliclona</i>									
	Coppatiidae	<i>Jospis</i>				r			r		
	Halicordriidae	<i>Stylotella</i>									
	Ianthellidae	<i>Ianthella</i>								r	
	Leucettida	<i>Pericharax</i>									
	Microcionidae	<i>Clathria</i>	r								
	Niphatidae	<i>Cribrochalia</i>								r	
	Niphatidae	<i>Gellodes</i>				r					
	Niphatidae	<i>Niphates</i>								r	
	Petrosiidae	<i>Xestospongia</i>	r		r					r	
	Plakinidae	<i>Plakortis</i>			r					r	
	Spongiidae	<i>Carteriospongia</i>					r	r			
	Spongiidae	<i>Demospongia</i>									
	Spongiidae	<i>Phyllospongia</i>						r			
	Theonellidae	<i>Theonella</i>					r	r			
	Unidentified sponge			r	r			r			
	Cnidaria	Actiniidae	<i>Entocmaea</i>					r			
		Acyoniidae	<i>Lobophyton</i>	r			f	r			
Acyoniidae		<i>Sarcophyton</i>	r			r			r		
Acyoniidae		<i>Sinularia</i>	r			r	r		r		
Anthothelidae		<i>Alertigorgia</i>				r					
Clavariidae		<i>Clavularia</i>					r				
Discomatidae		<i>Metarhodactis</i>				r					
Isidiidae		<i>Isis</i>				r					
Nephtheidae		<i>Dendronephthya</i>						r			
Plumulariidae		<i>Aglaophenia</i>	r	r		f	f	c			
Stichodactylidae		<i>Stichodactyla</i>						r			
Xeniidae		<i>Xenia</i>	f						r		
Zoanthidae		<i>Polythoa</i>						f			
Unidentified gorgonian								r	r		

Table S-5 cont.

Division	Family	Genus	Busuanga							
			L1	S1	S5	S6	S7	S8	S9*	S10
Mollusca	Bursidae	<i>Bursa rubeta</i>				r				
	Conidae	<i>Conus eburneus</i>								
	Conidae	<i>Virgiconus lividus</i>								
	Cypraeidae	<i>Cypraea annulus</i>	r							
	Fasciolaridae	<i>Drupella</i>								
	Fasciolaridae	<i>Pleroploca</i>								
	Ovulidae	<i>Ovula ovum</i>								
	Pectinidae	<i>Chlamys</i>								
	Pectinidae	<i>Pedum</i>	r	c	c	f	e			
	Phyllididae	<i>Phyllida</i>								
	Strombidae	<i>Lambis lambis</i>						r		
	Terebridae	<i>Terebra maculata</i>								
	Thaididae	<i>Morula sp.</i>								
	Tridacnidae	<i>Hippopus hippopus</i>				r				
	Tridacnidae	<i>Tridacna crocea</i>	c			f	f			r
	Tridacnidae	<i>Tridacna maxima</i>		f						
	Tridacnidae	<i>Tridacna squamosa</i>	r			r	f			f
	Tridacnidae	<i>Tridacna derasa</i>								
Vasidae	<i>Vasum</i>									
Annelida	Sabellidae	<i>Sabellastarte</i>						f		
	Serpulidae	<i>Spirobranchus</i>	c			c			c	
Echinodermata	Colobometridae	<i>Colobometra</i>		r				r		
	Comasteridae	<i>Comanthina</i>			r					
	Comasteridae	<i>Comanthus</i>		r	r					
	Comasteridae	<i>Oxycomanthus</i>								
	Diadematidae	<i>Diadema setosum</i>	c	r		r	r			r
	Diadematidae	<i>Echinothrix colamaris</i>	c		r		r			
	Diadematidae	<i>Echinothrix diadema</i>	f	r		r	c			f
	Echinometridae	<i>Echinotrepus</i>								
	Himerometridae	<i>Himerometra</i>				r				
Holothuridae	<i>Holothuria</i>		c							

Table S-5 cont.

Division	Family	Genus	Busuanga							
			I.I	S1	S5	S6	S7	S8	S9*	S10
Echinodermata	Ophiocoridae	<i>Ophiomasix</i>			r					
	Stichopodidae	<i>Stichopus</i>								
Protochordata	Clavelinidae	<i>Clavelina</i>					r			
	Diazonidae	<i>Rhopalaea</i>		r		f				
	Didemnidae	<i>Didemnum</i>		c			c			
	Styelidae	<i>Polycarpa</i>		r	r	r				
Bryozoa	Phidoloporidae	<i>Triphylozoon</i>				f			r	
	Schizoporellidae	<i>Stylopoma</i>		r						
Arthropoda		<i>Neaxius acanthus</i>								
			15	14	10	25	23	13	*	4
			52							

Source: Marine Survey, Study Team

cc = abundant; c = common; f = few; r = rare

* under heavy siltation, survey not possible

Table 5-6 Data on Coral, Seagrass, Seaweed, and Other Physical Measurements, Busuanga West

Busuanga														
Survey Site	Stn 1		Stn 5		Stn 6		Stn 7		Stn 8		Stn 9+		Stn 10	
Date	13-Sep		13-Sep		14-Sep		14-Sep		14-Sep		14-Sep		15-Sep	
Depth of survey range (m)	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-5	0-3	4-5
Number of coral genus	28	40	10	21	17	40	28	38	20	35				
Living coral cover (%)	60	80	<10	<10	40	50	90	50	90	100				
Dead coral cover (%)	30	20	30	20	30	20	10	50	<10	<10				
Large coral colony or microatoll	*	*			*	*	*	*	*	*				
Taxon														
<i>Pocillopora</i>	*				*		*							
<i>Seriatopora</i>	*		*		*	*	*							
<i>Stylophora</i>			*		*									
<i>Montipora</i> encrusting	*		*		*	*	*		*	*				
<i>Montipora</i> laminar			*		*		*		*	*				
<i>Montipora</i> arborescent		*	*		*	*	*	*	*	*				
<i>Anacropora</i>	*	A					*	A	*	*				
<i>Acropora (Isopora)</i>		*	*		*		*		*	*				
<i>Acropora</i> tabular					*		*		*	*				
<i>Acropora</i> arborescent	A	A			*	*	*		*	*				
<i>Acropora</i> polifera	*	*	*		*	*	*		*	*				
<i>Astreopora</i>			*		*	*	*		*	*				
<i>Porites</i> massive	A	A	*		*	*	A	A	A	A				
<i>Porites</i> arborescent	*	*	*		*	*	*	*	*	*				
<i>Goniopora</i>		*	*		*		*		*	*				
<i>Psammocora</i>		*			*		*		*	*				
<i>Pavona</i>	*		*		*		*		*	*				
<i>Leptoseris</i>		*			*		*		*	*				
<i>Gardineroseris</i>	*				*		*		*	*				
<i>Coeloseris</i>		*	*		*		*		*	*				
<i>Pachyseris</i>	*	*	*		*		*		*	*				
<i>Dioseris</i>			*		*		*		*	*				
<i>Heliopora</i>	*		*		*		*		*	*				
<i>Fungia</i>		*	*		*	*	*	A	*	*				
<i>Herpolitha</i>					*		*		*	*				
<i>Polyphyllia</i>	*				*		*		*	*				
<i>Halomitra</i>					*		*		*	*				
<i>Sandololitha</i>	*	*	*		*		*		*	*				

Table 5-6 cont.

Buuanga														
Survey Site	Stn 1		Stn 5		Stn 6		Stn 7		Stn 8		Stn 9+		Stn 10	
Date	13-Sep		13-Sep		14-Sep		14-Sep		14-Sep		14-Sep		15-Sep	
Depth of survey range (m)	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-5	0-3	4-5
<i>Lithophyllon</i>						*								
<i>Podobacia</i>		*												
<i>Galaxea</i>	*	A	*		*	*	*	*	*					
<i>Acrhelia</i>										*				
<i>Echinophyllia</i>	*				*	*	*	*		*				
<i>Oxypora</i>					*	*								
<i>Mycedium</i>						*				*				
<i>Pectinia</i>			*		*	*				*				
<i>Blastomussa</i>						*								
<i>Acanthastrea</i>						*				*				
<i>Lobophyllia</i>		*			*	*	*	*	*	*				
<i>Symphyllia</i>	*		*		*	*	*	*	*	*				
<i>Hydnophora</i>	*	*	*		*	*	*	*	*	*				
<i>Merulina</i>	*	*	*	*	*	*	*	*	*	*				
<i>Scapophyllia</i>										*				
<i>Caulastrea</i>														
<i>Favia</i>	*	*	*		*	*	*	*	*	*				
<i>Favites</i>	*	*	*		*	*	*	*	*	*				
<i>Goniastrea</i>	*		*		*	*	*	*	*	*				
<i>Platygyra</i>	*		*		*	*	*	*	*	*				
<i>Leptoria</i>		*			*	*				*				
<i>Oulophyllia</i>										*				
<i>Montastrea</i>		*				*				*				
<i>Oulastrea</i>														
<i>Pleslastrea</i>				*										
<i>Diplaostrea</i>	*					*								
<i>Leptastrea</i>	*		*		*	*	*	*	*	*				
<i>Cyphostrea</i>	*	*	*	*	*	*	*	*	*	*				
<i>Echinopora</i>	A	A			*	*	*	*	*	*				
<i>Euphyllia</i>	*		*		*	*	*	*	*	*				
<i>Pterogyra</i>										*				
<i>Physogyra</i>		*								*				
<i>Turbinaria</i>	*				*	*	*	*	*	*				

Table 5-6 cont.

Survey Site	Busuanga													
	Stn 1		Stn 5		Stn 6		Stn 7		Stn 8		Stn 9†		Stn 10	
	13-Sep		13-Sep		14-Sep		14-Sep		14-Sep		14-Sep		15-Sep	
Depth of survey range (m)	0-3	3-6.5	0-3	3-6.5	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-5	0-3	4-5
<i>Helipora</i>														
<i>Millepora arborescent</i>	*	*			*		*	*	*	*				
<i>Sylaster</i>							*	*						
Large dead coral colony														
<i>Seriatopora</i>	*	*	*		*		*	*	*	*				
<i>Acropora tabular</i>	*						*							
<i>Acropora arborescent</i>	*	*	*		*	*	*	*	*	*				
<i>Acropora corymbose</i>	*	*			*	*	*	*	*	*				
<i>Porites arborescent</i>	*	*			*	*	*	*	*	*				
Crown of thorns, <i>A. planci</i>	absent		absent		absent		absent		absent					
Evidence of coral damage	moderate		moderate		slight-moderate		moderate-severe		slight		severe		mod-severe	
Soft coral cover (%)	5-10		absent		10-20		10-20		10-20					
Seagrass Cover (%)	0	0	<10	<10		<10		0					<10	0
Common Seagrass species														
<i>Cymodocea serrulata</i>														
<i>Cymodocea rotundata</i>						*								
<i>Halodule uninervis</i>							*							
<i>Halodule pinifolia</i>														
<i>Enhalus acoroides</i>			*	*		*							*	*
<i>Halophila ovalis</i>													*	*
<i>Syringodium isoetifolium</i>														
<i>Thalassia hemprichii</i>														
Seaweed Cover (%)	0	<10-2	<10-3	<10		<10-12		<10					<10	<10
Common Seaweed species														
Chlorophyta														
<i>Halimeda velasquezii</i>						*							*	*
<i>Halimeda opuntia</i>		*				*		*					*	*
<i>Halimeda cylindracea</i>						*		*					*	*
<i>Halimeda discoidea</i>		*				*		*					*	*
<i>Halimeda incrossata</i>													*	*

Table 5-6 cont.

Busuanga														
Survey Site	Stn 1		Stn 5		Stn 6		Stn 7		Stn 8		Stn 9+		Stn 10	
Date	13-Sep		13-Sep		14-Sep		14-Sep		14-Sep		14-Sep		15-Sep	
Depth of survey range (m)	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-5	0-3	4-5
<i>Halimeda macroloba</i>			*	*		*								*
<i>Halimeda spp.</i>														
<i>Halimeda tuna</i>		*		*		*		*						*
<i>Udotea sp.</i>				*		*		*						*
<i>Tydemania expeditionis</i>														
<i>Anadyomene sp.</i>						*		*						*
<i>Coulerpa peltata</i>														*
<i>Coulerpa sertularioides</i>														*
<i>Cauperpa brachypus</i>														*
<i>Cauperpa sertularioides</i>		*												*
<i>Cauperpa racemosa</i>														*
<i>Coulerpa serrulata</i>		*												*
<i>Coulerpa taxifolia</i>														*
<i>Chlorodesmis comosa</i>		*						*						*
<i>Neomeris annulata</i>		*		*		*		*						*
<i>Bornetella nitida</i>														*
<i>Boodlea composita</i>														*
<i>Valonia ventricosa</i>														*
<i>Dictyosphaeria cavernosa</i>		*						*						*
<i>Halycoryne wrightii</i>														*
<i>Acetabularia major</i>														*
<i>Acetabularia minor</i>														*
<i>Boergesenia forbesii</i>														*
<i>Chaetomorpha crassa</i>														*
<i>Microdictyon sp.</i>						*								*
Phaeophyta														*
<i>Dictyota cervicornis</i>														*
<i>Dictyota dichotoma</i>			*			*		*						*
<i>Lobophora variegata</i>														*
<i>Padina australis</i>		*	*			*		*						*
<i>Padina japonica</i>														*
<i>Padina minor</i>		*	*			*		*						*
<i>Sargassum sp. 1</i>														*

Table 5-6 cont.

	Bustanga													
Survey Site	Stn 1		Stn 5		Stn 6		Stn 7		Stn 8		Stn 9+		Stn 10	
Date	13-Sep		13-Sep		14-Sep		14-Sep		14-Sep		14-Sep		15-Sep	
Depth of survey range (m)	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-6.5	0-3	3-5	0-3	3-5	0-3	4-5
<i>Sargassum</i> sp. 2			A											*
<i>Turbinoria decurrens</i>														
Rhodophyta														
<i>Actinotrichia fragilis</i>														
<i>Galaxaura oblongata</i>														
<i>Amphiroa foliacea</i>		*			*				*					
<i>Amphiroa anceps</i>														
<i>Amphiroa fragilissima</i>														
<i>Amphiroa marginata</i>														
<i>Ceratodicyon spongiosum</i>														*
<i>Hypnea cervicornis</i>		*												
<i>Hypnea esperi</i>			*	*										*
<i>Hypnea</i> sp.					*			*						*
<i>Galaxaura marginata</i>														
<i>Gelidiella acerosa</i>					*									*
<i>Gelidiopsis intricata</i>		*			*			*						*
<i>Gelidiopsis</i> sp.					*			*						*
<i>Gracilaria eucheimoides</i>				*	*									*
<i>Gracilaria salicornia</i>				*	*									*
<i>Gracilaria</i> sp. 1			*											*
<i>Mostophora rosea</i>														
<i>Acanthophora</i> sp.				*										
<i>Laurenzia papillosa</i>														*
<i>Laurenzia obtusa</i>									*					*
<i>Holymenia durvillaei</i>		*												
<i>Plocamium telfairiae</i>														
<i>Peyssonnelia</i> sp.								*						*
<i>Zellera tawallina</i>														
<i>Titanophora</i> sp.		*												
Cyanophyta		*			*			*						*
<i>Lyngbya</i> sp.		*			*			*						*
Situation	thin		medium		thin		thin		heavy		very heavy		medium	

Source: Marine Survey, Study Team

2) El Nido Case Study Area

(1) Physical Condition

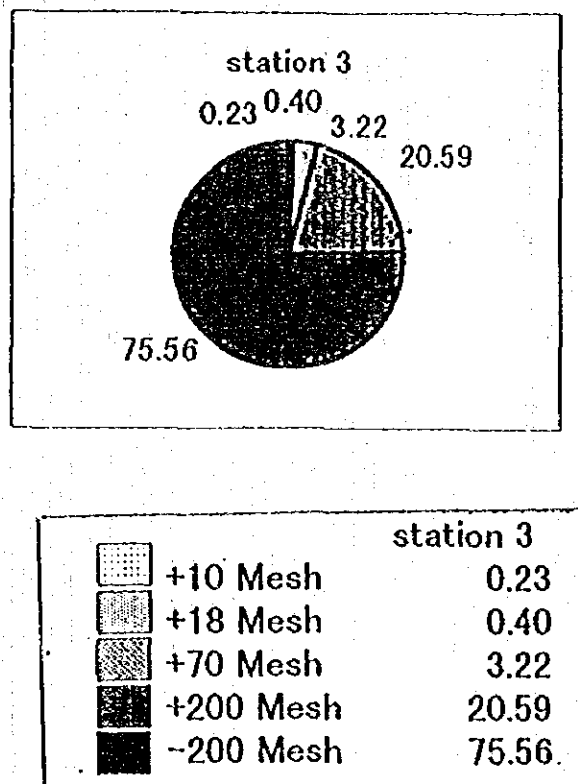
Tide and wave characteristics are similar to those in the Busuanga West Area due to the location which faces the South China Sea. Current measurement was carried out at a station for almost four (4) days successfully with a current meter (Figure 5-6). The northeast and NNE current prevailed during the measurement. The current velocity varied from 5cm/sec to 25cm/sec generally (Figure 5-7, 5-8, and 5-9). This maximum value seemed to be typical for outer reef region in the west coast of Northern Palawan.

(2) Chemical Condition

Water quality: There was no indication of the eutrophication from the results of chemical analysis on water quality parameters except in the El Nido Port area where impacts of human activities and COD_{Mn} concentration showed a high level (Figure 5-10).

Bottom sediment quality: Results of sediment analysis were shown in Figure 5-5. Though sediment sampling was done at only one (1) station due to the severe sea condition, it seemed that the outer reef area is predominated by muddy material.

Figure 5-5 Grain Size Distribution of Sea Bottom Sediment, El Nido



Source: Marine Survey, Study Team

(3) Biological Condition

Coral: Horizontal distribution of coral reef and live coral coverage were evaluated based on the aerial photographs and video images. Healthy coral reefs could not be found on the coast of the main island, but only around small offshore islands, such as Matinloc, Tapiutan and Guntao islands. Findings from the diving survey revealed a total of 58 genera present in this area (Table 5-7). Detailed distribution of coral species obtained at two (2) belt transect lines is illustrated and summarized in Figure 5-11 and 5-12 Table 5-8.

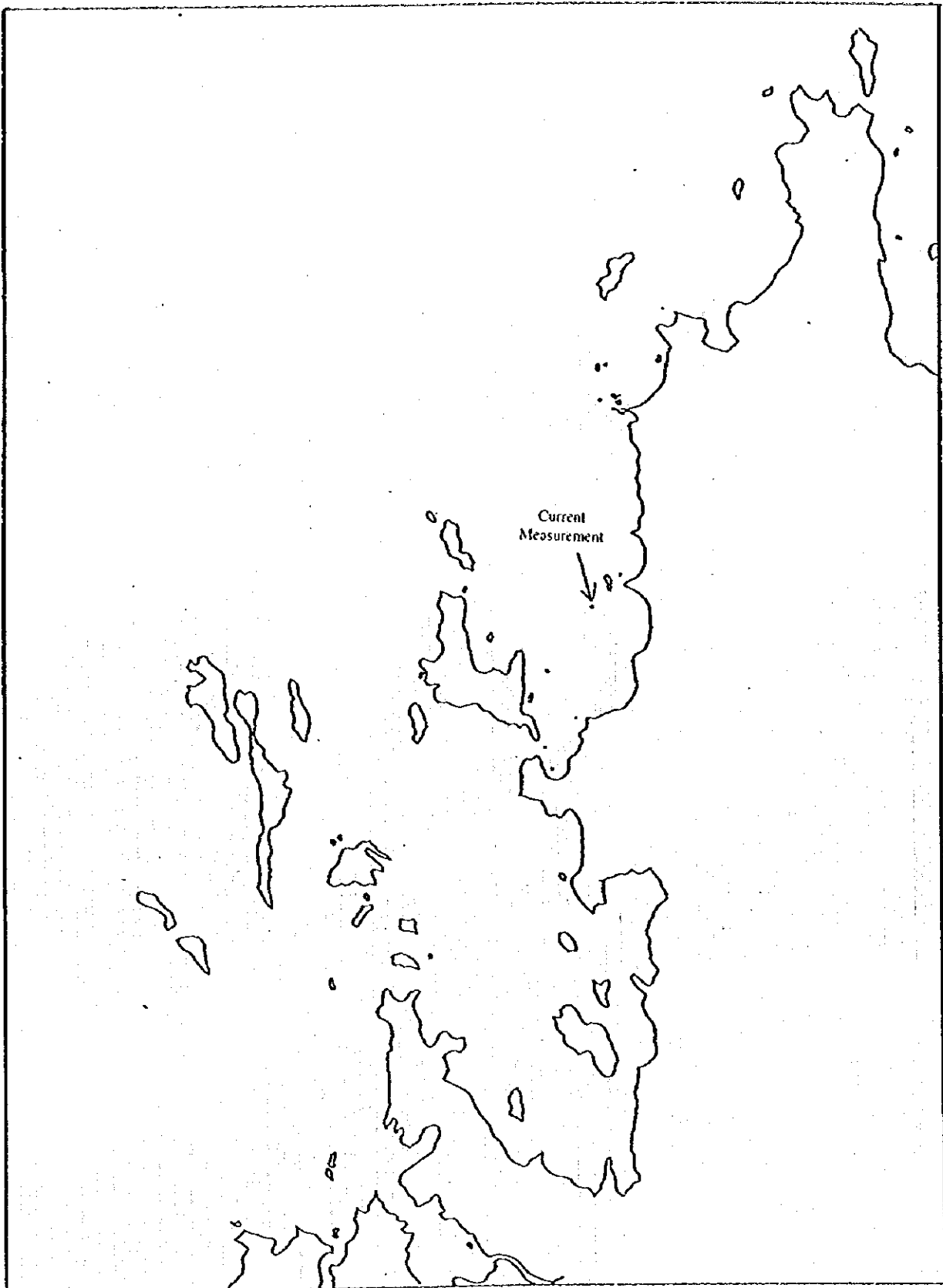
Seagrass / seaweed: Horizontal distribution of seagrass and seaweed beds and its coverage were evaluated based on the aerial observation. Seagrass is not abundant in this area and only small seagrass beds were found. On the other hand, seaweed beds were abundantly found mainly along the coast of the main island. Detailed distribution of seagrass/seaweed species is listed in Table 5-8, 5-9 and 5-10.

Reef-associated organisms: Findings from the diving survey are summarized in Table 5-11 and 5-12 for macro-invertebrates and reef-associated fish, respectively. A total of 170 fish species and 53 genera of macro-invertebrates were found in the EI Nido area. Target species for fisheries, such as groupers (Serranidae), snappers (Lutjanidae) and emperors (Lathrinidae), were not abundant and were in the small-class size, in general.

Mangrove: The location and extent of mangrove forests were shown in Figure 3-6. Mangrove forests in this area are small in the extent and have been affected by human impacts.

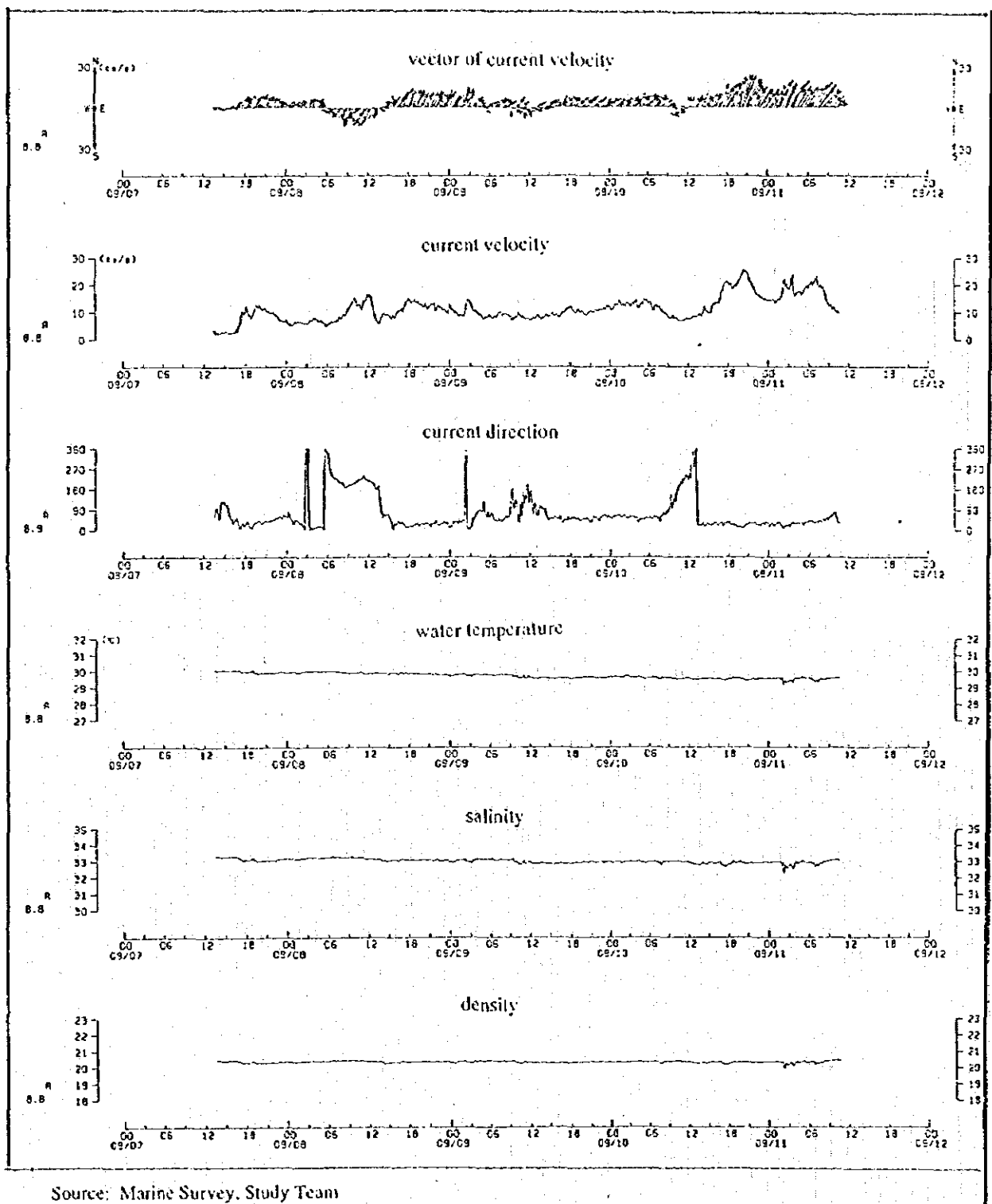
Endangered marine wildlife: This area has been known that dugongs and sea turtles are often observed. The Study Team also found a dugong and several sea turtles during the field survey period of five (5) days. There are confirmed nesting grounds of hawksbill sea turtles at offshore small islands.

Figure 5-6 Location of Current Measurements



Source: Marine Survey, Study Team

Figure 5-7 Characteristics of Current Together with Water Temperature, Salinity and Density, Sept. 7 to 11, 1996



Source: Marine Survey. Study Team

Figure 5-8 Current Direction and Velocity, Sept. 7-11, 1996

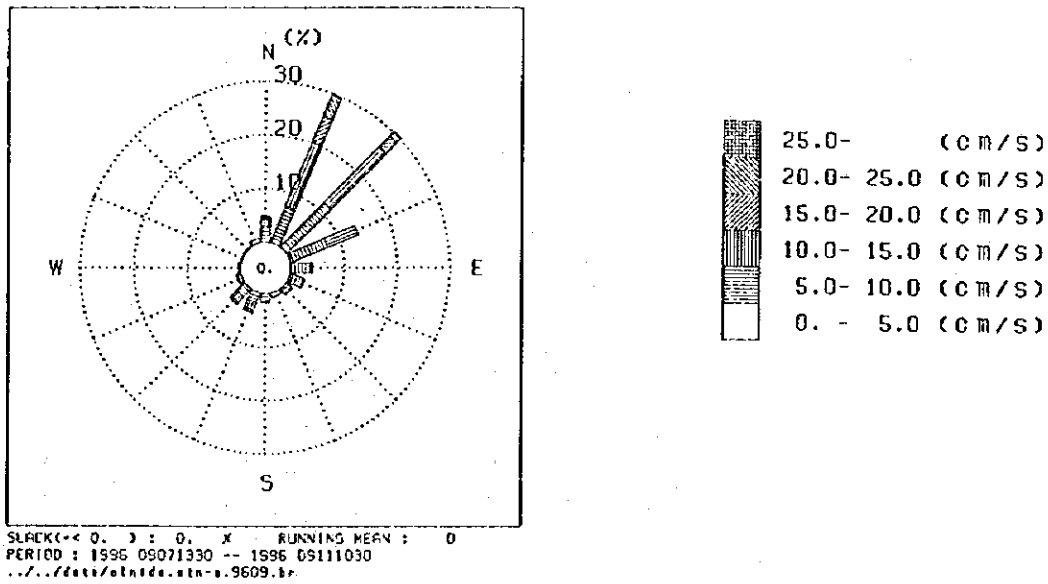


Figure 5-9 Frequency of Current Velocity, Sept. 7-11, 1996

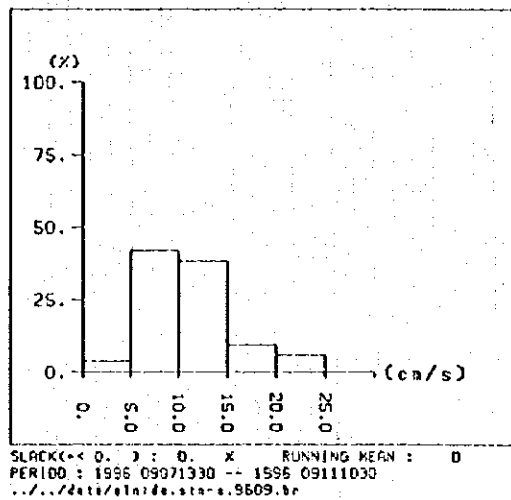


Figure 5-10 Water Quality Distribution, El Nido

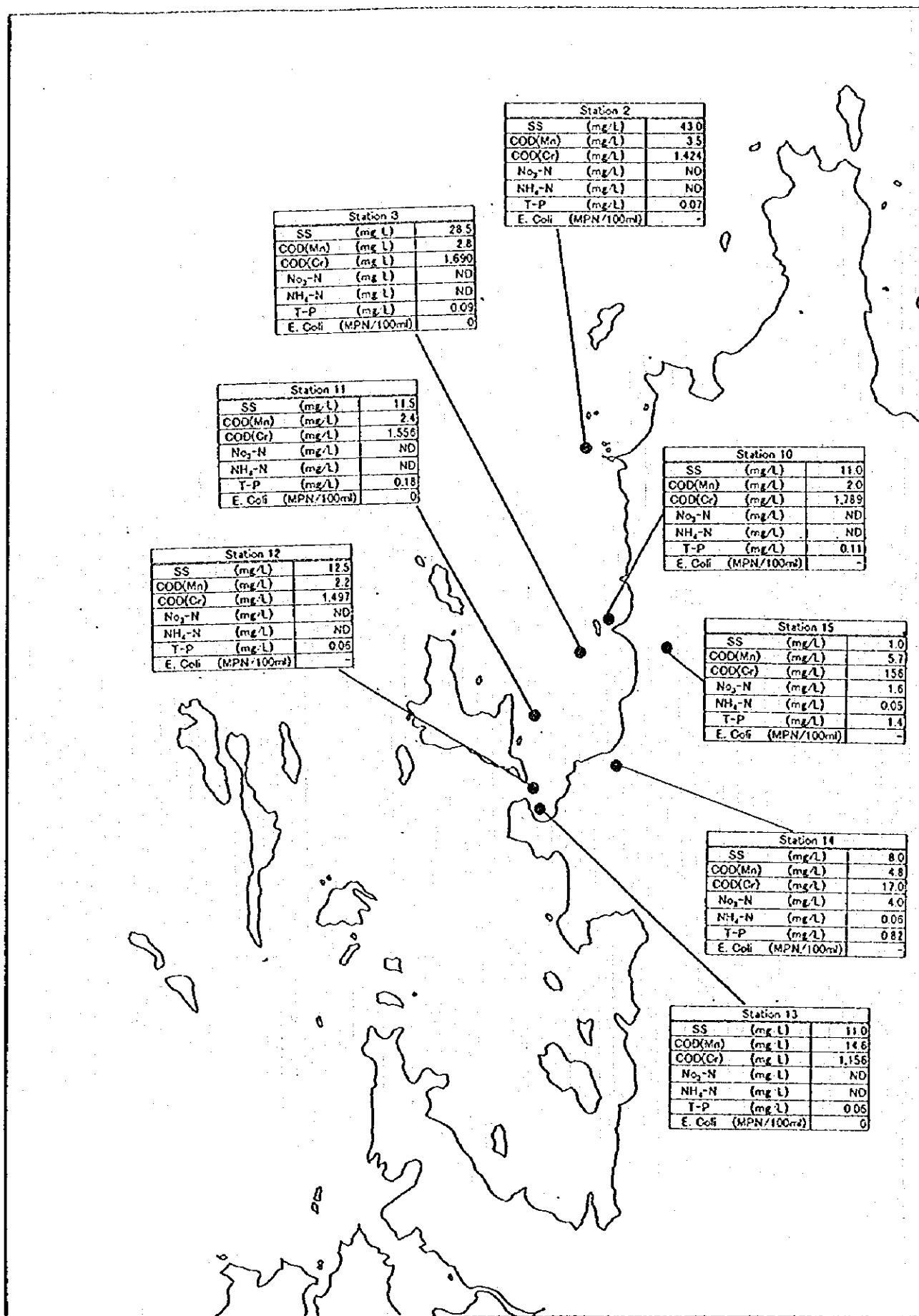


Table 5-7 Coral Generic Composition and Abundance, El Nido

Family	Genus	Colony Form	El Nido					
			Line 1	Line 2	Sta. 1	Sta. 2	Sta. 3	Sta. 4
Pocilloporidae	<i>Pocillopora</i>		f	r	r	r		c
	<i>Seriatopora</i>		f	f	c	f		f
	<i>Stylophora</i>		f		f	r		
Acroporidae	<i>Montipora</i>	encrusting	f	r	c	c	c	c
	<i>Montipora</i>	arborescent	r	r	r	f	f	f
	<i>Anacropora</i>							
	<i>Acropora (Isopora)</i>							
	<i>Acropora</i>	tabular	c	cl	r	r	c	r
	<i>Acropora</i>	arborescent	cc	e	e	f	c	c
	<i>Acropora</i>	corymbose	c	r	r	r		f
	<i>Acropora</i>	caespitose	f		r			r
	<i>Acropora</i>	digitate	r			r		r
	<i>Acropora</i>	bottle-brush	c	c	c	r		r
	<i>Astreopora</i>		f	r	cl	f	f	r
Poritidae	<i>Porites</i>	massive	ccL	c	ccL	c	ccL	f
	<i>Porites</i>	arborescent		c	r	r	M	r
	<i>Gonolopora</i>		f			f		f
	<i>Alveopora</i>		r	r				
Siderastreidae	<i>Psammocora</i>							c
Agariciidae	<i>Pavona</i>		f					f
	<i>Leptoseris</i>		f					fl
	<i>Gardineroseris</i>					r		r
	<i>Coeloseris</i>		r			r		r
	<i>Pachyseris</i>		r		r		cl	r
Fungiidae	<i>Diaeris</i>		r		r			
	<i>Heliofungia</i>		r			r	f	r
	<i>Fungia</i>		f	f		r	f	r
	<i>Herpolitha</i>							

Table 5-7 cont.

Family	Genus	Colony Form	El Nido					
			Line 1	Line 2	Sta. 1	Sta. 2	Sta. 3	Sta. 4
Fungiidae	<i>Polyphyllia</i>				r			
	<i>Halomitra</i>		rL					
	<i>Sandalolitha</i>							
	<i>Lithophyllon</i>		fl		r			
	<i>Podobacia</i>		r					r
Oculinidae	<i>Galaxea</i>		c	c		f		f
	<i>Acrhelia</i>							r
Pectiniidae	<i>Echnophyllia</i>		r	r				r
	<i>Oxypora</i>		r					
	<i>Mycedium</i>		r		rL			rL
	<i>Pectinia</i>		fl	r	fl	r		r
Mussidae	<i>Blastomussa</i>		r					
	<i>Cynarina</i>		r					
	<i>Acanthostrea</i>		r		r			rL
	<i>Lobophyllia</i>		fl	r	r			f
	<i>Symphylia</i>		f		fl	rL		r
Merulinidae	<i>Hydnophora</i>		f	fM	f	r	fM	
	<i>Merulina</i>		f	r	cl			r
	<i>Scopophyllia</i>		r	r				r
Faviidae	<i>Conastrea</i>				r	r		
	<i>Favta</i>		c	cl	c	f	c	cl
	<i>Barabattola</i>			r				
	<i>Favites</i>		c	c	c	c	fl	
	<i>Goniastrea</i>		c	fl	f			f
	<i>Platygyra</i>		f	fl	fl	fl		cl
	<i>Leptoria</i>		r		r			
	<i>Oulophyllia</i>		r	r	r			rL
	<i>Montastrea</i>		r	r				

Table 5-7 cont.

Family	Genus	Colony Form	El Nido					
			Line 1	Line 2	Sta. 1	Sta. 2	Sta. 3	Sta. 4
Faviidae	<i>Onlostrea</i>							r
	<i>Plesiastrea</i>							
	<i>Diploastrea</i>		r			r		f
	<i>Leptastrea</i>		f					
	<i>Cyphastrea</i>		f	f	f	f	r	r
	<i>Echinopora</i>		fl.	r	f	r	f	f
Trachyphylliidae	<i>Trachyphyllia</i>		r					
Caryophylliidae	<i>Euphyllia</i>		r	r	f	f		fl.
	<i>Pterogyra</i>							r
	<i>Phytogyra</i>							f
Dendrophylliidae	<i>Turbinaria</i>		r	r	fl.	r	r	f
Tubiporidae	<i>Tubipora</i>		r					
Helioporidae	<i>Heliopora</i>		r	r	r	r	f	rL
Milleporidae	<i>Millepora</i>	encrusting	r					
	<i>Millepora</i>	arborescent	r				r	
Stylasteridae	<i>Stylaster</i>							
Total			56	32	35	33	18	46
			66					

Source: Marine Survey, Study Team

Legend- cc: abundant; c: common; f: few; r: rare

L: colony diameter: more than 1 meter, M: microatoll or large monospecific stand.

Figure S-11 Percentage cover of dominant coral genera, seagrass and seaweed, substrate type of siltation at Belt Transect 1, El Nido, Northern Palawan.

Date: 7 Sep. 1996
 Distance (m)

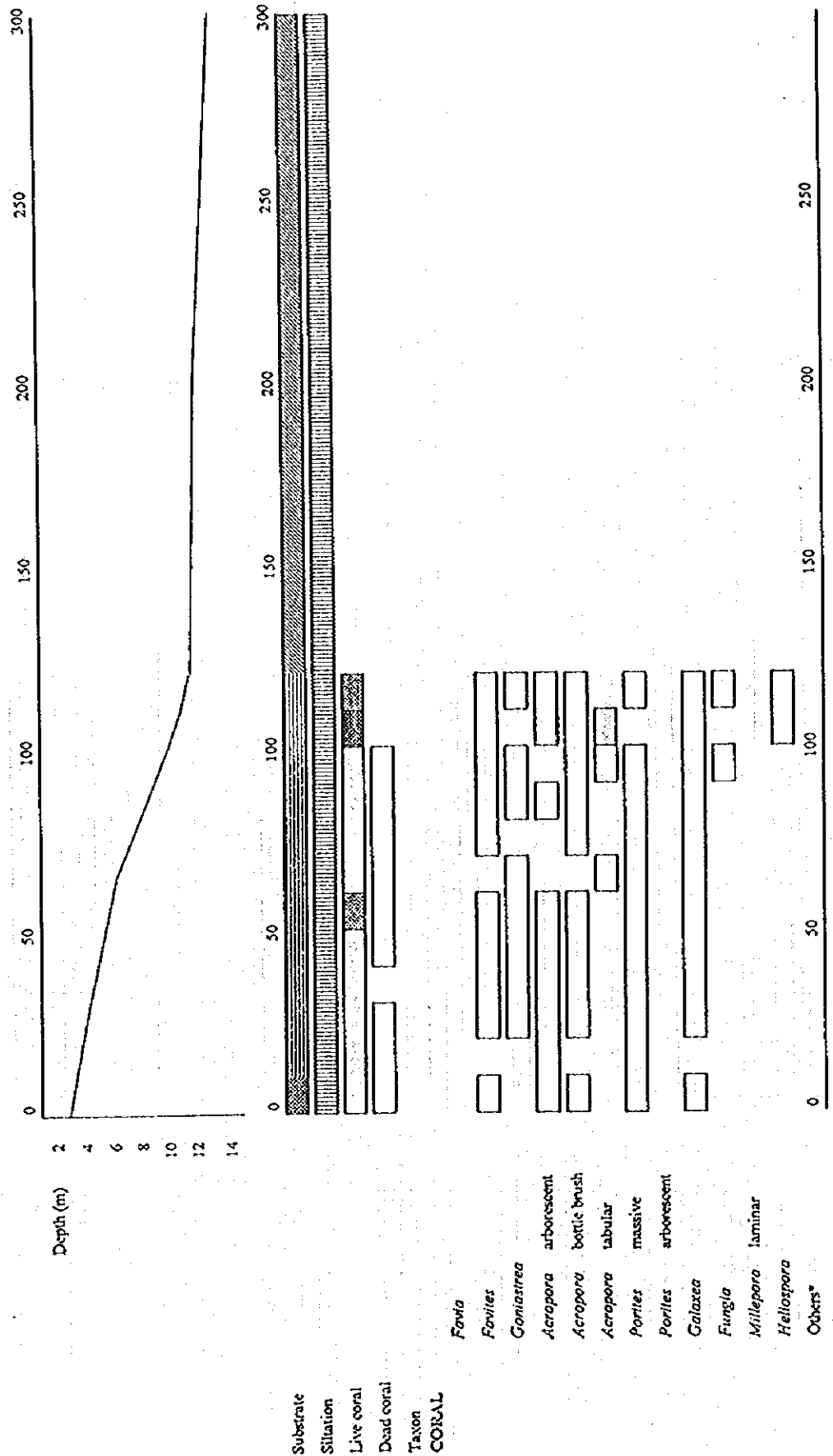
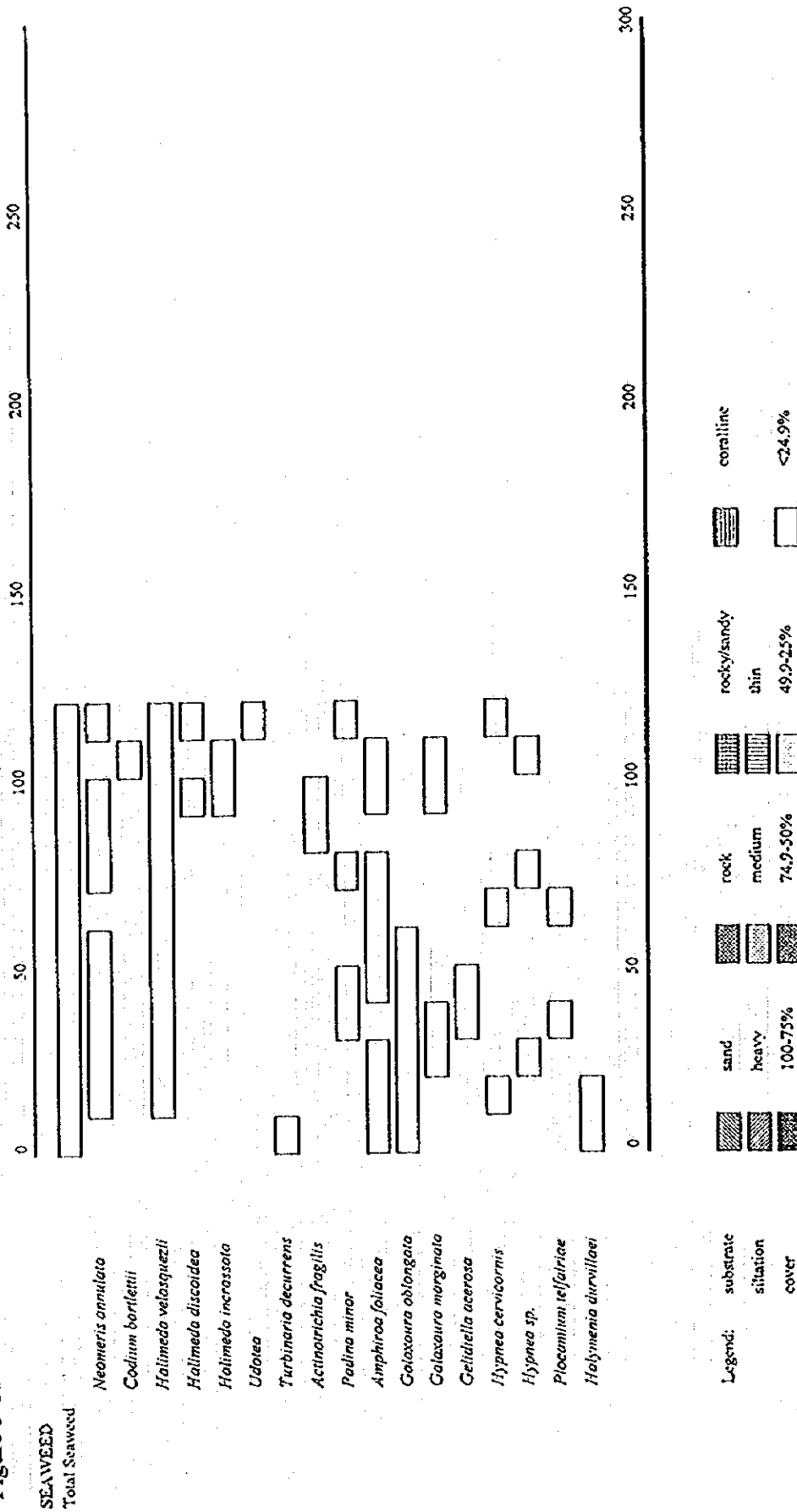


Figure 5-11 cont.



* species encountered with less than 10% cover throughout the entire length of the transect, refer to table 3.

Source: Marine Survey, Study Team

Figure 5-12 Percentage cover of dominant coral genera, seaweed and seaweed, substrate type of siltation at Belt Transect 2, El Nido, Northern Palawan.

Date: 8 Sep. 1996

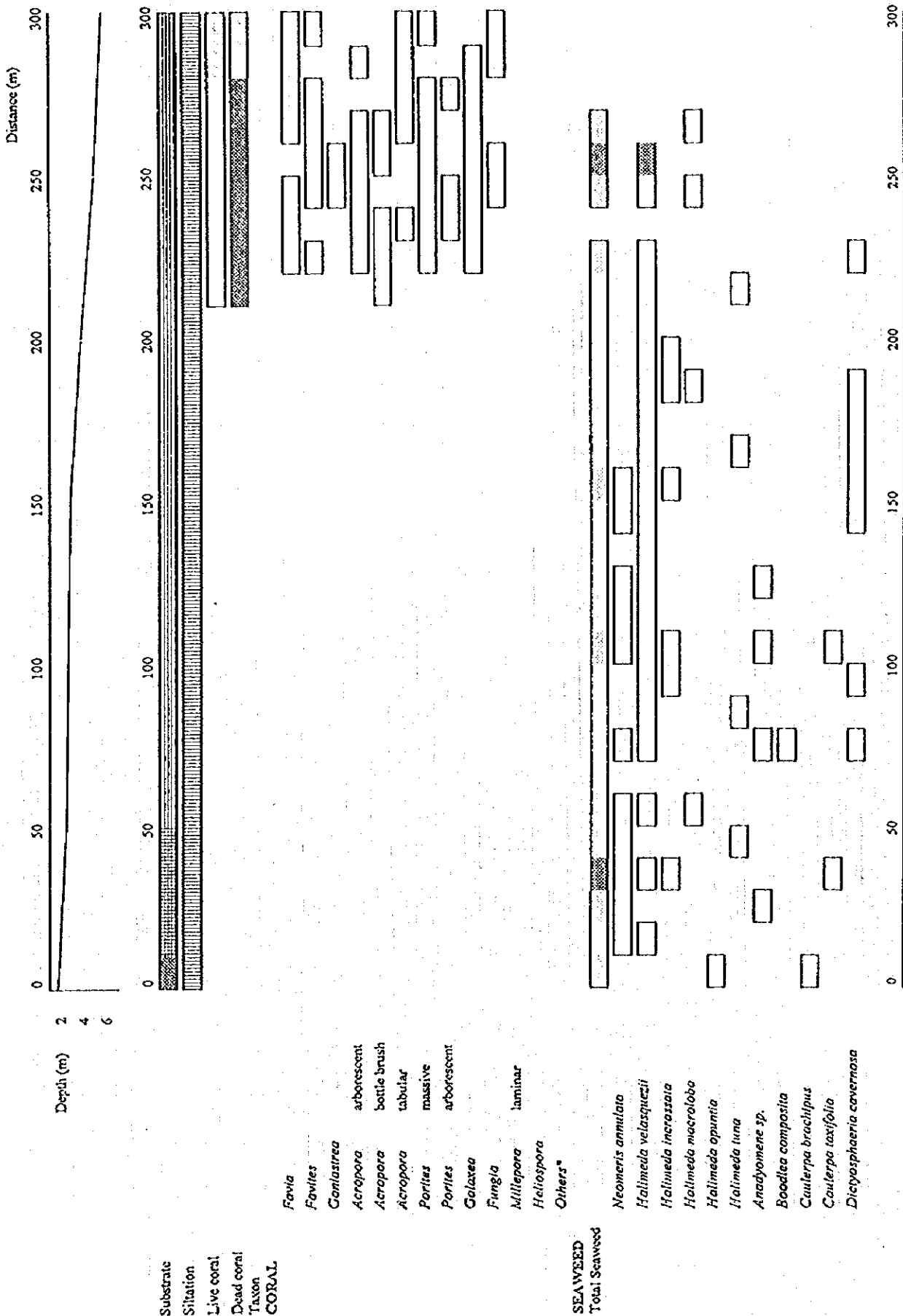
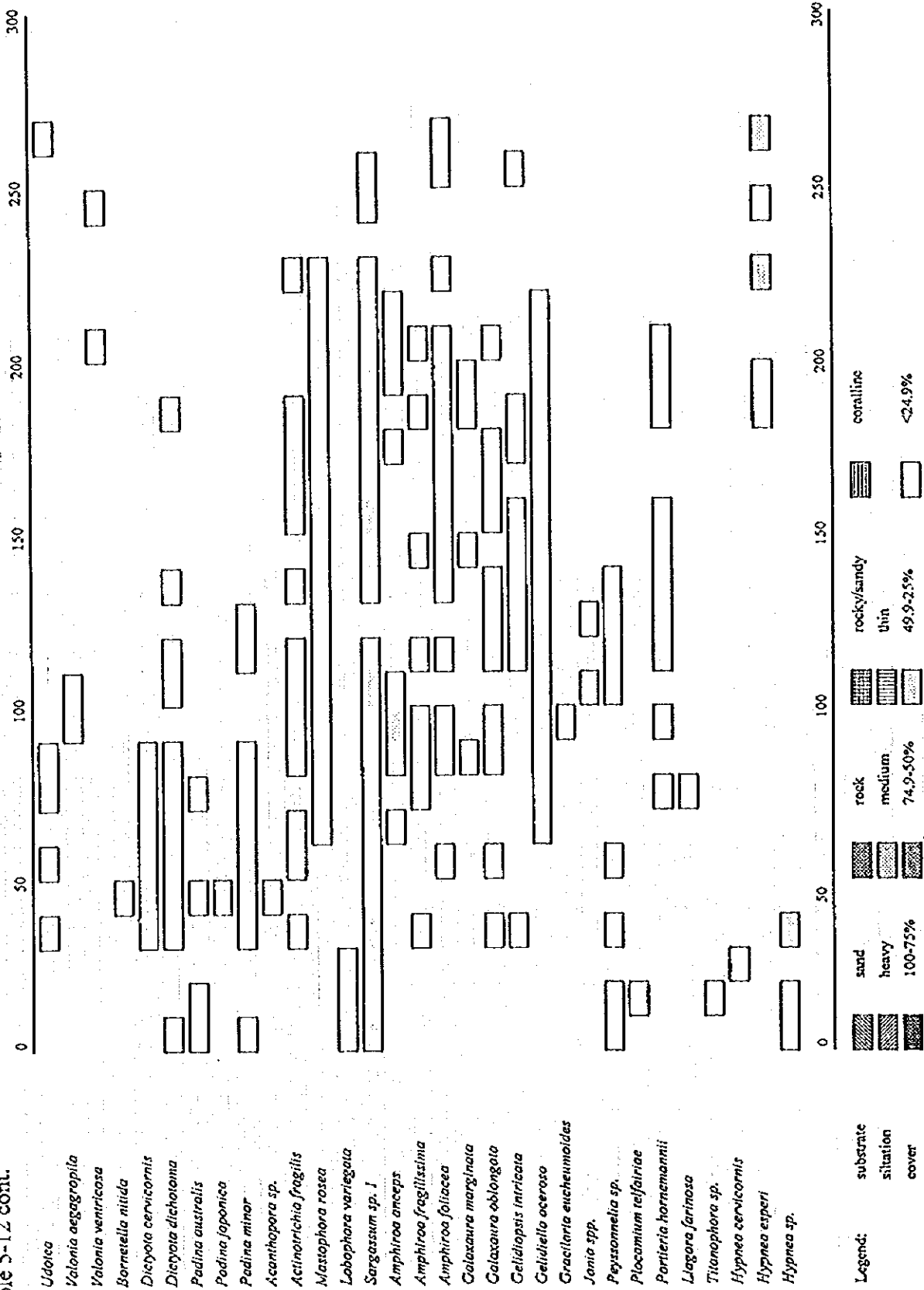


Table 5-12 cont.



* species encountered with less than 10% cover throughout the entire length of transect, refer to table 4.

Source: Marine Survey, Study Team

Table S-8 cont.

Distance (m)	0	50	100	150	200	250	300
<i>Ocyropsa</i>	*						
<i>Myxocodium</i>			*				
<i>Pectinia</i>							
<i>Blastomussa</i>				*			
<i>Cynarina</i>		*					
<i>Acanthastrea</i>		*					
<i>Labophyllia</i>		*					
<i>Symphylia</i>	*		*				
<i>Hydnophora</i>		*					
<i>Merulina</i>		*					
<i>Scopophyllia</i>	*						
<i>Platygyra</i>		*					
<i>Leptaria</i>	*		*				
<i>Outophyllia</i>					*		
<i>Montastrea</i>		*					
<i>Diploastrea</i>	*				*		
<i>Cyphastrea</i>		*	*				
<i>Echinopora</i>	*	*			*		
<i>Trachyphyllia</i>			*				
<i>Euphyllia</i>			*				
<i>Turbinaria</i>			*	*			
<i>Tubipora</i>					*		
<i>Seagrass</i> ⁶¹							
Total Seagrass Cover (%)							
Seaweeds							
Total Seaweed Cover (%)	*	*	*	*	*	*	*
Chlorophyta							
<i>Codium bartlettii</i>			*				
<i>Neomeris annulata</i>	*	*	*	*	*	*	*
<i>Halimeda discoidea</i>		*	*	*	*	*	*
<i>Halimeda incrassata</i>			*	*	*	*	*

Table 5-8 cont.

Distance (m)	0	50	100	150	200	250	300
<i>Ulaimeda velasquezii</i>							
<i>Ulotea</i>							
Phaeophyta							
<i>Padina minor</i>							
<i>Turbinaria decurrens</i>							
Rhodophyta							
<i>Acinorichia fragilis</i>							
<i>Amphiroa foliacea</i>							
<i>Galaxaura marginata</i>							
<i>Galaxaura oblongata</i>							
<i>Gelidium acerosa</i>							
<i>Talymenia divvilaei</i>							
<i>Hypnea cervicornis</i>							
<i>Hypnea sp.</i>							
<i>Plocamium telfairiae</i>							

Note: * <10% cover, (A) Absent.

Source: Marine Survey, Study Team

Table S-9 cont.

Distance (m)	0	50	100	150	200	250	300
<i>Thalassia</i>							
<i>Sargassum</i> (s)							
Total Seagrass Cover (%)							
Sewweeds							
Total Seaweed Cover (%)	47	22	35	62	*	11	*
Chlorophyta							
<i>Acidomyces</i> sp.							
<i>Boodleia composita</i>							
<i>Caulerpa brachyptis</i>	*						
<i>Caulerpa taxifolia</i>							
<i>Dicysphaeria cavernosa</i>							
<i>Neomeris ornithota</i>							
<i>Halimeda incrassata</i>							
<i>Halimeda maculoloba</i>							
<i>Halimeda opuntia</i>	*						
<i>Halimeda tuna</i>							
<i>Halimeda veloxicell</i>							
<i>Ulva</i>							
<i>Valonia aegagropila</i>							
<i>Valonia venricosa</i>							
<i>Bornetella nitida</i>							
Phaeophyta							
<i>Dictyota cervicornis</i>							
<i>Dictyota dichotoma</i>							
<i>Lobophora variegata</i>							
<i>Padina australis</i>							
<i>Padina japonica</i>							
<i>Padina minor</i>							
<i>Sargassum</i> sp. 1	31	21	24	35	*	10	*
<i>Rhodophyta</i>							
<i>Acanthopora</i> sp.							
<i>Actinotrichia fragilis</i>							
<i>Amphiroa fragilisima</i>							
<i>Amphiroa foliacea</i>							

Table S-9 cont.

Distance (m)	0	50	100	150	200	250	300
<i>Symphiroa anceps</i>			•				
<i>Galaxaura marginata</i>			•				
<i>Galaxaura oblongata</i>		•	•	•	•		
<i>Ceidiopsis intricata</i>		•	•	•	•		
<i>Ceidiella acerosa</i>		•	•	•	•	•	
<i>Gracilaria eucheumoides</i>			•				
<i>Hypnea cervicornis</i>							
<i>Hypnea</i> sp.	15	•	27				
<i>Hypnea esperi</i>					•	•	•
<i>Jania</i> spp.			•	•	•	•	•
<i>Mastophora rosea</i>			•	•	•	•	•
<i>Peysommelia</i> sp.	•	•	•	•	•	•	•
<i>Placomium teliforme</i>		•					
<i>Porieria hornemannii</i>			•	•	•	•	•
<i>Liagora farinosa</i>			•				
<i>Titanophora</i> sp.		•					

Note: " = <10% cover; (A), absent

Source: Marine Survey, Study Team

Table 5-10 Seagrass and Seaweed Recorded in El Nido

Division	Family	Species	Line 1	Line 2	St. 1	St. 2	St. 3	St. 4
Seagrass								
SPERMATOPHYTA	Hydrocharitaceae	<i>Enhalus acoroides</i>				r		r
	Hydrocharitaceae	<i>Halophila ovalis</i>				f		r
	Hydrocharitaceae	<i>Syringodium isoetifolium</i>				r		
	Hydrocharitaceae	<i>Thalassia hemprichii</i>				r		r
	Potamogetonaceae	<i>Cymodocea rotundata</i>				f		r
	Potamogetonaceae	<i>Cymodocea serrulata</i>				f		
	Potamogetonaceae	<i>Halodule pinifolia</i>				r		
	Potamogetonaceae	<i>Halodule uninervis</i>				r		
Seaweed								
CHLOROPHYTA (Green Algae)	Boodleaaceae	<i>Boodlea composita</i>		r				r
	Caulerpaceae	<i>Caulerpa serrulata</i>				f		r
	Caulerpaceae	<i>Caulerpa sertularioides</i>						r
	Caulerpaceae	<i>Caulerpa taxifolia</i>		r		r		r
	Caulerpaceae	<i>Caulerpa brachypus</i>		r			r	r
	Cladophoraceae	<i>Anadyomene sp.</i>		r		r		r
	Cladophoraceae	<i>Cheatomorpha crassa</i>				r		
	Codiumaceae	<i>Codium bartlettii</i>	r					
	Dasycladaceae	<i>Acetabularia major</i>					r	r
	Dasycladaceae	<i>Acetabularia minor</i>			r			
	Dasycladaceae	<i>Bornetella nitida</i>		r		r		
	Dasycladaceae	<i>Halycoryne wrightii</i>						r
	Dasycladaceae	<i>Neomeris annulata</i>	r	r	r	r	r	r
	Halimedaceae	<i>Halimeda cylindraceae</i>						r
	Halimedaceae	<i>Halimeda discoidea</i>	r			r	f	r
	Halimedaceae	<i>Halimeda incrassata</i>	r	r		r	r	
	Halimedaceae	<i>Halimeda maculata</i>					f	r
	Halimedaceae	<i>Halimeda opuntia</i>		r			f	r
	Halimedaceae	<i>Halimeda spp.</i>				r	r	r
	Halimedaceae	<i>Halimeda tuna</i>		f		r	f	
	Halimedaceae	<i>Halimeda velosquezii</i>	r		f			r
	Udoteaceae	<i>Chlorodesmis comosa</i>						r
	Udoteaceae	<i>Tydemania expeditionis</i>						r
	Udoteaceae	<i>Udotea sp.</i>	r	r		r		r
	Valoniaceae	<i>Dictyosphaeria cavernosa</i>		r		r	r	r
	Valoniaceae	<i>Valonia aegagropita</i>		r				
	Valoniaceae	<i>Valonia ventricosa</i>		r		r		r
PHAEOPHYTA								
(Brown Algae)	Dictyotaceae	<i>Dictyota cervicornis</i>		r		r		
	Dictyotaceae	<i>Dictyota dichotoma</i>		r		r		r
	Dictyotaceae	<i>Lobophora variegata</i>		f				
	Dictyotaceae	<i>Padina australis</i>		r		r		r
	Dictyotaceae	<i>Padina japonica</i>		r				
	Dictyotaceae	<i>Padina minor</i>	r	r	r	r	r	r
	Sargassaceae	<i>Sargassum sp. 2</i>						f
	Sargassaceae	<i>Sargassum sp. 1</i>		f		c		
Sargassaceae	<i>Turbinaria decurrens</i>	r					r	

Table 5-10 cont.

Division	Family	Species	Line 1	Line 2	St. 1	St. 2	St. 3	St. 4
RHODOPHYTA (Red Algae)	Galaxauraceae	<i>Actinotrichia fragilis</i>	r		r	r	r	r
	Galaxauraceae	<i>Galaxaura oblongata</i>	r	r	r	r		r
	Corallinaceae	<i>Amphiroa foliacea</i>	r	r	r		r	r
	Corallinaceae	<i>Amphiroa anceps</i>		r				
	Corallinaceae	<i>Amphiroa fragilissima</i>		r	r			r
	Corallinaceae	<i>Jania spp.</i>		r				
	Corallinaceae	<i>Mastophora rosea</i>		r		r	f	
	Helmintholadaceae	<i>Liagora farinosa</i>		r				
	Hypneaceae	<i>Hypnea cervicornis</i>	r	r	r	c		f
	Hypneaceae	<i>Hypnea esperi</i>		c				r
	Hypneaceae	<i>Hypnea sp.</i>	r	f				
	Galaxauraceae	<i>Galaxaura marginata</i>	r	r	r			
	Gelidiellaceae	<i>Gelidiella ocerosa</i>	r	r	r	r		
	Gracilariaceae	<i>Gelidiopsis sp.</i>		r	r	r		r
	Gracilariaceae	<i>Ceratodictyon spongiosum</i>					r	
	Gracilariaceae	<i>Gracilaria eucheunoides</i>		r				r
	Gracilariaceae	<i>Gracilaria salicornia</i>						
	Rhodomelaceae	<i>Acanthophora sp.</i>		r				
	Rhodomelaceae	<i>Laurencia papillosa</i>		r		r		
	Rhodomelaceae	<i>Laurencia obtusa</i>				r		r
	Halymeniaceae	<i>Halymenia durvilloi</i>	r			r		r
	Plocamiaceae	<i>Plocanium telfairiae</i>	r	r			r	r
	Peyssonelliaceae	<i>Peyssonellia sp.</i>		r				r
Delesseriaceae	<i>Zellera sawallina</i>					r		
Rhizophyllidaceae	<i>Portieria hornemanii</i>		r					
Nemastomataceae	<i>Titanophora sp.</i>		r					
CYANOPHYTA (Blue-green Algae)	Oscillatoriaceae	<i>Lyngbya sp.</i>			r		r	r
			17	40	14	35	21	39
			70					

cc = abundant; c = common; f = few; r = rare.

Source: Marine Survey, Study Team

Table 5-11 Associated Macro-invertebrates Recorded at the Survey Sites, El Nido

Division	Family	Genus	El Nido					
			L1	L2	S1	S2	S3	S4
Porifera	Aplysiniidae	<i>Aplysina</i>					r	
	Callyspongiidae	<i>Callyspongia</i>						
	Chalinidae	<i>Haliclona</i>	r					
	Coppatidae	<i>Jaspis</i>						r
	Halicondriidae	<i>Stylotella</i>	r					
	Ianthellidae	<i>Ianthella</i>			r	r		
	Leucettida	<i>Pericharax</i>	r					
	Microcionidae	<i>Clothria</i>						
	Niphatidae	<i>Cribrachalia</i>						
	Niphatidae	<i>Gelliodes</i>						
	Niphatidae	<i>Niphates</i>						
	Petrosiidae	<i>Xestospongia</i>						
	Plakinidae	<i>Plakortis</i>						
	Spongiidae	<i>Carteriospongia</i>	r					r
	Spongiidae	<i>Demospongia</i>				r	r	
	Spongiidae	<i>Phyllospongia</i>	r		r	r		
	Theonellidae	<i>Theonella</i>						
	Unidentified sponge						r	
Cnidaria	Actiniidae	<i>Entacmaea</i>						
	Alcyoniidae	<i>Lobophyton</i>			r		r	r
	Alcyoniidae	<i>Sarcophyton</i>			r	r	r	r
	Alcyoniidae	<i>Sinularia</i>			r	r	r	r
	Anthothelidae	<i>Alertigorgia</i>						
	Clavulariidae	<i>Clavularia</i>						
	Discomatidae	<i>Metarhodactis</i>					c	
	Isidiidae	<i>Isis</i>						
	Nephtheidae	<i>Dendronephytha</i>			r			
	Plumulariidae	<i>Agloophenta</i>	r	r	r	r	r	r
	Stichodactylidae	<i>Stichodactylo</i>	r		r		r	
	Xeniidae	<i>Xenia</i>					r	
	Zoanthidae	<i>Polythoa</i>			r			
	Unidentified gorgonian				r			

Table 5-11 cont.

Division	Family	Genus	EINdo						
			L1	L2	S1	S2	S3	S4	
Mollusca	Bursidae	<i>Bursa rubeta</i>		f					
	Conidae	<i>Conus eburneus</i>		f					
	Conidae	<i>Virgiconus lividus</i>			r	r			
	Cypracidae	<i>Cypraea annulus</i>		r					
	Fasciariidae	<i>Drupella</i>					c		
	Fasciariidae	<i>Pteroploca</i>							r
	Ovulidae	<i>Ovula ovum</i>	r		r				
	Pectinidae	<i>Chlamys</i>		r	f				
	Pectinidae	<i>Pedum</i>			f	f			c
	Phyllidiidae	<i>Phyllidia</i>							r
	Strombidae	<i>Lambis lambis</i>		r					r
	Terebridae	<i>Terebra maculata</i>	r	r					
	Thaididae	<i>Morula sp.</i>			r				
	Tridacnidae	<i>Hippopus hippopus</i>						f	
	Tridacnidae	<i>Tridacna crocea</i>			r			c	c
	Tridacnidae	<i>Tridacna maxima</i>						r	
	Tridacnidae	<i>Tridacna squamosa</i>	r		r			c	f
	Tridacnidae	<i>Tridacna derasa</i>	f		f	f			
	Vasidae	<i>Vasum</i>	r						
Annelida	Sabellidae	<i>Sabellastarte</i>							
	Serpulidae	<i>Spirobranchus</i>	f	c	c	c	f	r	
Echinodermata	Colobometridae	<i>Colobometra</i>	r			r			
	Comasteridae	<i>Comanthina</i>							
	Comasteridae	<i>Comanthus</i>							
	Comasteridae	<i>Oxycomanthus</i>					r	r	
	Diadematidae	<i>Diadema setosum</i>	f	f					f
	Diadematidae	<i>Echinothrix calamaris</i>				r	f		
	Diadematidae	<i>Echinothrix diadema</i>	r	f	r				
	Echinometridae	<i>Echnotrephus</i>	r	r	r				
	Himerometridae	<i>Himerometra</i>							
	Holothuridae	<i>Holothuria</i>	r	r		r			

Table 5-11 cont.

Division	Family	Genus	El Nido					
			L1	L2	S1	S2	S3	S4
Echinodermata	Ophiocomidae	<i>Ophiomastix</i>						
	Stichopodidae	<i>Stichopus</i>				r		r
Protochordata	Clavelinidae	<i>Clavelina</i>						
	Diazonidae	<i>Rhopalaea</i>	r	r	r			f
	Didemnidae	<i>Didemnum</i>		f	f	c		f
	Styelidae	<i>Polycarpa</i>	r	r	r	f		f
Bryozoa	Thidoloporidae	<i>Triphylozoon</i>	r		f	f		r
	Schizoporellidae	<i>Stylopoma</i>			f			
Arthropoda		<i>Neaxius acanthus</i>		c		c		c
			21	16	25	19	19	21
			53					

cc = abundant; c = common; f = few; r = rare

* under heavy siltation, survey not possible

Source: Marine Survey, Study Team

Table 5-12 Reef-associated Fish Species Recorded at Survey Areas, El Nido

Core Group	Family	Taxonomy	El Nido					
			Line1	Line2	Stn1	Stn2	Stn3	Stn4
Target	Serranidae	<i>Cephalopholis boenak</i>	r					
		<i>Diplorhynchus bifasciatus</i>	r		r			r
		<i>Epinephelus fasciatus</i>	r					
		<i>Epinephelus merra</i>						r
		<i>Plectropomus leopardus</i>	r					
	Siganidae	<i>Siganus argenteus</i>	f				cc	
		<i>Siganus spinus</i>		c				
		<i>Siganus virgatus</i>	f			c		
		<i>Siganus vulpinus</i>						r
	Caesionidae	<i>Coesio caerulea</i>	cc					
		<i>Coesio cuning</i>	f				cc	cc
		<i>Pterocaesio diagramma</i>						cc
		<i>Pterocaesio tile</i>						cc
		<i>Pterocaesio trilineata</i>						
	Carangidae	<i>Atule mate</i>						
	Haemulidae	<i>Plectorhynchus diagramma</i>	r	r	r			
		<i>Plectorhynchus pictus</i>	r					
	Lethrinidae	<i>Gnathodentex aurolineatus</i>					f	
		<i>Lethrinus horak</i>					r	
		<i>Lethrinus olivaceus</i>					r	
		<i>Lethrinus sp. 1</i>	r					
		<i>Lethrinus sp. 2</i>		f				
	Lutjanidae	<i>Lutjanus corponotatus</i>	r	r			r	
		<i>Lutjanus decussatus</i>	r	r	r	r		
		<i>Lutjanus fulviflamma</i>	f					
		<i>Lutjanus fulvus</i>		r				
		<i>Lutjanus rivulatus</i>	r					
		<i>Lutjanus timorensis</i>						r
		<i>Lutjanus vitta</i>						
	Acanthuridae	<i>Acanthurus grammoptilus</i>		r				
<i>Acanthurus lineatus</i>		f					r	
<i>Acanthurus olivaceus</i>			r					
<i>Acanthurus triostegus</i>		f						
<i>Ctenochaetus binotatus</i>		r		r	r	f		

Table 5-12 cont.

Core Group	Family	Taxonomy	El Nido					
			Line1	Line2	Stn1	Stn2	Stn3	Stn4
		<i>Ctenochaetus striatus</i>	f		f			
		<i>Naso annulatus</i>	f	r				
		<i>Naso lituratus</i>					f	
		<i>Zebrosoma veliferum</i>						
Major	Labridae	<i>Anampses caeruleopunctatus</i>						r
		<i>Bodianus toxozonus</i>					r	
		<i>Bodianus mesothorax</i>	r		r			r
		<i>Cheilinus celebicus</i>	r					
		<i>Cheilinus chlorourus</i>	r	r	r			
		<i>Cheilinus trilobatus</i>			r	r		
		<i>Cheilinus unifasciatus</i>					r	
		<i>Cheilio inermis</i>	r	r		r		
		<i>Choerodon anchorago</i>				r		
		<i>Coris gaimard</i>			r			
		<i>Coris schroederi</i>	r		r		f	
		<i>Diproctacanthus xanthurus</i>	r	r	r			
		<i>Epibulus insidiator</i>	r				r	
		<i>Gomphosus varius</i>			r		r	
		<i>Halichoeres chloropterus</i>						
		<i>Halichoeres hortulanus</i>	r		r			r
		<i>Halichoeres marginatus</i>						
		<i>Halichoeres melanurus</i>	r	f	r	r		
		<i>Halichoeres nebulosus</i>	r	f	f			
		<i>Halichoeres prosopeton</i>	r					
		<i>Hemigymnus fasciatus</i>			r		r	
		<i>Hemigymnus melapterus</i>	r			r	r	
		<i>Lobrichthys unilineatus</i>				r	r	
		<i>Lobroides dimidiatus</i>			r			
		<i>Macropharyngodon meleagris</i>	r		f			
		<i>Pteragogus cryptus</i>				r		
		<i>Stethojulis bandanensis</i>		r	f		r	
		<i>Stethojulis strigiventer</i>	f					
		<i>Stethojulis trilineata</i>	r					
		<i>Thalassoma hardwicke</i>	f				r	

Table 5-12 cont.

Core Group	Family	Taxonomy	El Nido					
			Line1	Line2	Stn1	Stn2	Stn3	Stn4
		<i>Thalassoma lunare</i>	cc	f	c		c	
	Mullidae	<i>Parupeneus barberinoides</i>	f	f		f		
		<i>Parupeneus barberinus</i>	r			r	f	
		<i>Parupeneus bifasciatus</i>						r
		<i>Parupeneus cyclostomus</i>			r			
		<i>Parupeneus indicus</i>	r			c		
		<i>Parupeneus multifasciatus</i>	r		f	r	f	
		<i>Parupeneus pleurostigma</i>						r
		<i>Mulloides vanicolensis</i>						
		<i>Upeneus tragula</i>	r					f
	Nemipteridae	<i>Monotaxis grandoculis</i>					r	
		<i>Pentapodus coninus</i>					f	
		<i>Pentapodus nemurus</i>		r				
		<i>Scolopsis bilineatus</i>	r	r	r	r		
		<i>Scolopsis ciliatus</i>			r			c
		<i>Scolopsis lineatus</i>	r					
		<i>Scolopsis morganiifer</i>		c		c		
		<i>Scolopsis monogramma</i>	r				r	
		<i>Scolopsis sp. 1</i>						
	Pomacanthidae	<i>Chaetodontoplus mesoleucus</i>					r	
		<i>Pomacanthus semicirculatus</i>	r		r			
		<i>Pomacanthus sexstriatus</i>						
		<i>Pygoplites diacanthus</i>					r	
	Pomacentridae	<i>Abudefduf saxatilis</i>						
		<i>Abudefduf sexfasciatus</i>			c		c	
		<i>Abudefduf troschali</i>	f	r				
		<i>Aconthochromis polyacanthus</i>	f		f		cc	cc
		<i>Amblyglyphidodon curacao</i>	r		f		cc	f
		<i>Amblyglyphidodon leucogaster</i>						
		<i>Amblypomacentrus breviceps</i>						
		<i>Amphiprion akallopis</i>	r					
		<i>Amphiprion clarkii</i>	r					
		<i>Amphiprion frenatus</i>						

Table 5-12 cont.

Core Group	Family	Taxonomy	El Nido					
			Line1	Line2	Stn1	Stn2	Stn3	Stn4
		<i>Chromis ambolnensis</i>						
		<i>Chromis sp. 1</i>						
		<i>Chromis viridis</i>					cc	
		<i>Chromis weberi</i>	cc					
		<i>Chromis xanthura</i>					f	
		<i>Chrysiptera parasema</i>						
		<i>Chrysiptera springeri</i>						
		<i>Dascyllus aruanus</i>						f
		<i>Dascyllus melanurus</i>						
		<i>Dascyllus reticulatus</i>	f		f		cc	
		<i>Dascyllus trimaculatus</i>	f					
		<i>Dischistodus melanotus</i>					f	f
		<i>Dischistodus perspicillatus</i>						f
		<i>Dischistodus prosopotaenia</i>		r		r		f
		<i>Neoglyphidodon melas</i>	r	r	r		f	r
		<i>Neoglyphidodon nigeris</i>	r		r		f	r
		<i>Neoglyphidodon oxyodon</i>	r					
		<i>Neopomacentrus anabatooides</i>					cc	
		<i>Neopomacentrus ozysron</i>					f	
		<i>Plectroglyphidodon dickii</i>	r					
		<i>Plectroglyphidodon lacrymatus</i>	f		f		f	
		<i>Pomacentrus alexanderae</i>		f			c	cc
		<i>Pomacentrus ambolnensis</i>	c			f	c	
		<i>Pomacentrus aqullus</i>						
		<i>Pomacentrus bankanensis</i>	r		f		f	
		<i>Pomacentrus burroghi</i>						
		<i>Pomacentrus chrysurus</i>						
		<i>Pomacentrus coelestis</i>	f	cc	cc		f	
		<i>Pomacentrus graminorhynchus</i>						
		<i>Pomacentrus leptogenys</i>	r		f		f	
		<i>Pomacentrus moluccensis</i>	f				c	c
		<i>Pomacentrus smithi</i>					cc	cc
		<i>Pomacentrus sp. 1</i>		r		r		
		<i>Pomacentrus sp. 2</i>			f		f	

Table 5-12 cont.

Core Group	Family	Taxonomy	El Nido					
			Line1	Line2	Stn1	Stn2	Stn3	Stn4
		<i>Pomacentrus sp. 3</i>				r		
		<i>Pomacentrus sp. 4</i>						
		<i>Pomacentrus sp. 5</i>						
		<i>Pomacentrus stigma</i>			f			
		<i>Premnas bioculeatus</i>					r	
		<i>Stegastes obreptus</i>	r					
		<i>Stegastes sp. 1</i>						
	Pseudochromidae	<i>Labraechnus melanotaenia</i>	r					
		<i>Ogilbyina sp.</i>						
	Scoridae	<i>Cetoscarus bicolor</i>						
		<i>Hipposcarus longiceps</i>	f				f	f
		<i>Scarus bleekeri</i>	r					
		<i>Scarus dimidiatus</i>					r	f
		<i>Scarus flavipectoralis</i>						
		<i>Scarus frenatus</i>	r				c	
		<i>Scarus hyselopterus</i>					r	
		<i>Scarus niger</i>					r	
		<i>Scarus schlegeli</i>						
		<i>Scarus sordidus</i>	r		f		f	r
		<i>Scarus sp. 1</i>					f	
		<i>Scarus sp. 2</i>						
	Holocentridae	<i>Myripristis kuntee</i>	r					
		<i>Neoniphon somnora</i>					r	
		<i>Sargocentron rubrum</i>	r					
	Sphyraenidae	<i>Sphyraena flavicauda</i>		f				
Indicator	Chaetodontidae	<i>Chaetodon auriga</i>	r		r	r		
		<i>Chaetodon baronessa</i>			f			r
		<i>Chaetodon benetti</i>						
		<i>Chaetodon citrinellus</i>	r					
		<i>Chaetodon kleinii</i>	r	r	r		f	
		<i>Chaetodon lineolatus</i>	f					
		<i>Chaetodon lunula</i>	r				r	
		<i>Chaetodon melannotus</i>						
		<i>Chaetodon octofasciatus</i>	f		f			r

Table 5-12 cont.

Core Group	Family	Taxonomy	El Nido						
			Line1	Line2	Stn1	Stn2	Stn3	Stn4	
		<i>Chaetodon ornatisimus</i>					r		
		<i>Chaetodon trifasciatus</i>					r	f	
		<i>Chaetodon nlietensis</i>				r			
		<i>Chaetodon unimaculatus</i>					r		
		<i>Chaetodon vagabundus</i>	f						
		<i>Chaetodon xanthurus</i>	r		r				
		<i>Chelmon rostratus</i>				r			
		<i>Coradion chryzotonus</i>							
		<i>Ifentochus chryzotomus</i>							
Others	Apogonidae	<i>Apogon angustatus</i>							
		<i>Apogon compressus</i>							
		<i>Apogon sp. 1</i>		f		e			
		<i>Apogon sp. 2</i>		f					
		<i>Apogon sp. 3</i>				r			
		<i>Apogon sp. 4</i>							
		<i>Apogon sp. 5</i>							
		<i>Archaemia zosterophora</i>					ee		
		<i>Cheilodipterus macrodon</i>	f					f	
		<i>Cheilodipterus subulatus</i>							
		Tetraodontidae	<i>Arothron hispidus</i>			r			
			<i>Arothron nigropunctatus</i>					r	
			<i>Arothron stellatus</i>						
			<i>Canthigaster bennetti</i>				r		
			<i>Canthigaster valentini</i>			r			
		Monacanthidae	<i>Cantherines pardalis</i>	r					
			<i>Cantherines sp. 1</i>				r		
			<i>Paraluteres prionurus</i>				r		
			<i>Paramonocanthus japonicus</i>					r	
		Balistidae	<i>Rhinecanthus oculatus</i>		r				
<i>Rhinecanthus verrucosus</i>									
		<i>Sufflamen chrysopterus</i>	f	r	r		f		
	Aulostomidae	<i>Aulostomus chinensis</i>							
	Blenniidae	<i>Meiacanthus sp.</i>							
	Centriscidae	<i>Aeoliscus strigatus</i>				r			

Table 5-12 cont.

Core Group	Family	Taxonomy	El Nido					
			Line1	Line2	Stn1	Stn2	Stn3	Stn4
	Centropomidae	<i>Psommoperca sp.</i>		r				
	Ephippidae	<i>Platax orbicularis</i>						
		<i>Platax pinnatus</i>					r	
	Fistulariidae	<i>Fistularia commersonii</i>	r					
	Microdesmidae	<i>Ptereleotris evides</i>	r					
	Gobiidae	<i>Isigobius regilius</i>						
		<i>Amblygobius decussatus</i>						
	Kyphosidae	<i>Kyphosus cinerascens</i>	f				r	
	Opistognathidae	<i>Opistognathus sp.</i>				r		
	Pempheridae	<i>Pempheris ovalensis</i>				cc		cc
	Pinguipedidae	<i>Parapercis hexoptalma</i>						r
	Plotosidae	<i>Plotosus lineatus</i>						
	Scorpaenidae	<i>Dendrochirus zebra</i>	r					
	Zanclidae	<i>Zanclus cornutus</i>	r		r	r		f
			88	34	48	38	64	28
			170					

cc = abundant; c = common; f = few; r = rare

* under heavy siltation, survey not possible.

Source: Marine Survey, Study Team

Table 5-13 Data on Coral, Seagrass, Seaweed and other Physical Measurements, El Nido

El Nido								
Survey Site	Stn 1		Stn 2		Stn 3		Stn 4	
Date	8-Sep		10-Sep		9-Sep		9-Sep	
Depth of survey range (m)	0-3	3-6	0-3	3-6	0-3	3-6.5	0-3	3-5
Number of coral genus	17	30	25	30	7	12	22	42
Living coral cover (%)	30	50	<10	<10	90	60	70	80
Dead coral cover (%)	20	20	<10	<10	10	40	30	20
Large coral colony or microatoll			*		*	*	*	*
Taxon								
<i>Pocillopora</i>	*		*				*	*
<i>Seriatopora</i>		*	*	*				*
<i>Sylophora</i>	*		*					
<i>Montipora</i> encrusting	*	*	*	*	*		*	*
<i>Montipora</i> laminar			*	*			*	*
<i>Montipora</i> arborescent		*	*	*	*	*	*	*
<i>Anacropora</i>								
<i>Acropora (Isopora)</i>								
<i>Acropora</i> tabular	*	*	*	*	*	*	*	*
<i>Acropora</i> arborescent			*	*	*	*	*	*
<i>Acropora</i> <i>palifera</i>					*		*	*
<i>Astreopora</i>			*		*	*	*	*
<i>Porites</i> massive	A	A	*	*	A	A	*	*
<i>Porites</i> arborescent				*	*	*	*	*
<i>Goniopora</i>			*				*	*
<i>Psammocora</i>								*
<i>Pavona</i>							*	*
<i>Leptoseris</i>								*
<i>Gardineroseris</i>				*				*
<i>Coeloseris</i>				*			*	*
<i>Pachyseris</i>		*				*	*	*
<i>Diaaseris</i>	*						*	*
<i>Heliofungia</i>				*	*		*	*
<i>Fungia</i>			*		*		*	*
<i>Herpolitha</i>							*	*
<i>Polyphyllia</i>		*						
<i>Holomitra</i>								
<i>Sandalolitha</i>								

Table 5-13 cont.

El Niño								
Survey Site	Stn 1		Stn 2		Stn 3		Stn 4	
Date	8-Sep		10-Sep		9-Sep		9-Sep	
Depth of survey range (m)	0-3	3-6	0-3	3-6	0-3	3-6.5	0-3	3-5
<i>Lithophyllon</i>				*				
<i>Podabocla</i>								*
<i>Galaxea</i>			*	*			*	
<i>Acrhelia</i>							*	
<i>Echinophyllia</i>								*
<i>Oxypora</i>								
<i>Mycedium</i>	*						*	*
<i>Pectinia</i>		*	*		*			
<i>Blastomussa</i>								
<i>Acanthostrea</i>	*						*	
<i>Lobophyllia</i>		*					*	*
<i>Symphyllia</i>	*		*	*			*	*
<i>Hyalnophora</i>	*		*		*	*		
<i>Merulina</i>		*					*	*
<i>Scapophyllia</i>							*	
<i>Caulastrea</i>		*		*				
<i>Favia</i>	*	*	*		*		*	*
<i>Favites</i>	*	*	*	*		*		
<i>Gonastrea</i>		*					*	
<i>Ploygyra</i>	*			*			*	*
<i>Leptoria</i>	*							
<i>Oulophyllia</i>	*							
<i>Montastrea</i>								
<i>Oulastrea</i>								*
<i>Plesiastrea</i>								
<i>Diploastrea</i>				*			*	*
<i>Leptastrea</i>								
<i>Cyphastrea</i>	*		*		*			*
<i>Echinopora</i>		*		*		*	*	*
<i>Euphyllia</i>	*		*	*			*	*
<i>Pterogyra</i>							*	*
<i>Physogyra</i>							*	*
<i>Turbinaria</i>	*	*	*			*		*

Table 5-13 cont.

Survey Site	El Nido							
	Stn 1		Stn 2		Stn 3		Stn 4	
	8-Sep		10-Sep		9-Sep		9-Sep	
Depth of survey range (m)	0-3	3-6	0-3	3-6	0-3	3-6.5	0-3	3-5
<i>Heliopora</i>		*	*		*	*	*	*
<i>Millepora arborescent</i>		*			*			
<i>Stylaster</i>								
Large dead coral colony								
<i>Seriatopora</i>	*	*			*	*	*	
<i>Acropora tabular</i>	*	*	*	*	*	*	*	*
<i>Acropora arborescent</i>	*	*	*	*	*	*	*	*
<i>Acropora corymbose</i>	*	*			*	*	*	*
<i>Porites arborescent</i>		*			*	*	*	*
Crown of thorns, <i>A. planci</i>	absent		absent		absent		absent	
Evidence of coral damage	slight		moderate		moderate-severe		slight-moderate	
Soft coral cover (%)	25-30		10-20		10-20		5-10	
Seagrass Cover (%)		0	<10-2	<10-1	0	0	<10	<10
Common Seagrass species								
<i>Cymodocea serrulata</i>			*	*				
<i>Cymodocea rotundata</i>			*				*	
<i>Halodule uninervis</i>			*	*				
<i>Halodule pinifolia</i>				*				
<i>Enhalus acoroides</i>				*			*	
<i>Halophila ovalis</i>				*			*	
<i>Syringodium isoetifolium</i>			*					
<i>Thalassia hemprichii</i>			*				*	
Seaweed Cover (%)		<10	<10-3	<10-2	<10	<10-20	<10	<10-15
Common Seaweed species								
Chlorophyta								
<i>Halimeda velasquezii</i>		*					*	
<i>Halimeda opuntia</i>					*	*		*
<i>Halimeda cylindracea</i>					*	*		*
<i>Halimeda discordea</i>				*	*	*		*
<i>Halimeda incrossata</i>			*	*	*	*		*

Table 5-13 cont.

El Nido								
Survey Site	Stn 1		Stn 2		Stn 3		Stn 4	
Date	8-Sep		10-Sep		9-Sep		9-Sep	
Depth of survey range (m)	0-3	3-6	0-3	3-6	0-3	3-6.5	0-3	3-5
<i>Halimeda maculosa</i>					*			*
<i>Halimeda</i> spp.			*		*		*	*
<i>Halimeda tuna</i>			*		*			
<i>Udotea</i> sp.				*				*
<i>Tydemania expeditionis</i>							*	
<i>Anadyomene</i> sp.			*	*			*	
<i>Caulerpa peltata</i>								
<i>Caulerpa sertularioides</i>								*
<i>Caulerpa brachypus</i>						*		*
<i>Caulerpa sertularioides</i>								
<i>Caulerpa racemosa</i>								
<i>Caulerpa serrulata</i>			*	*				*
<i>Caulerpa taxifolia</i>			*					*
<i>Chlorodesmis comosa</i>					*			
<i>Neomeris annulata</i>		*	*	*		*	*	
<i>Bornetella nitida</i>			*					
<i>Boodleia composita</i>							*	*
<i>Valonia ventricosa</i>			*				*	*
<i>Dicysphaeria cavernosa</i>			*			*		*
<i>Halycoreyne wrightii</i>						*		
<i>Acetabularia major</i>			*					*
<i>Acetabularia minor</i>		*						*
<i>Boergesenia forbesii</i>			*					
<i>Chaetomorpha crassa</i>			*	*				
<i>Microdictyon</i> sp.								
Phaeophyta								
<i>Dicyota cervicornis</i>			*	*				
<i>Dicyota dichotoma</i>			*	*				*
<i>Lobophora variegata</i>								
<i>Padina australis</i>				*				*
<i>Padina japonica</i>								
<i>Padina minor</i>		*		*		*	*	*
<i>Sargassum</i> sp. 1			*	*				

Table 5-13 cont.

El Nido								
Survey Site	Stn 1		Stn 2		Stn 3		Stn 4	
Date	8-Sep		10-Sep		9-Sep		9-Sep	
Depth of survey range (m)	0-3	3-6	0-3	3-6	0-3	3-6.5	0-3	3-5
<i>Sargassum sp. 2</i>								*
<i>Turbinaria decurrens</i>								*
Rhodophyta								
<i>Actinotrichia fragilis</i>		*	*	*		*		*
<i>Galaxaura oblongata</i>		*		*				*
<i>Amphiroa foliacea</i>		*			*	*	*	*
<i>Amphiroa anceps</i>								
<i>Amphiroa fragilissima</i>		*						*
<i>Amphiroa marginata</i>								
<i>Ceratodictyon spongiosum</i>						*		
<i>Hypnea cervicornis</i>		*	*	*				*
<i>Hypnea esperi</i>								*
<i>Hypnea sp.</i>								
<i>Galaxaura marginata</i>								
<i>Gelidiella acerosa</i>		*	*					
<i>Gelidiopsis intricata</i>								
<i>Gelidiopsis sp.</i>		*	*					*
<i>Groenlandia eucheumoides</i>								*
<i>Groenlandia salicornia</i>								
<i>Groenlandia sp. 1</i>								
<i>Mastophora rosea</i>			*			*		
<i>Acanthophora sp.</i>								
<i>Laurencia papillosa</i>			*					
<i>Laurencia obtusa</i>		*				*		
<i>Halymenia durvillaei</i>			*					*
<i>Plocamium telfairiae</i>					*		*	
<i>Peyssonnelia sp.</i>								*
<i>Zellera towallina</i>						*		*
<i>Titanophora sp.</i>								*
Cyanophyta								
<i>Lyngbya sp.</i>		*				*		*
Siltation		thin		thin		thin		thin

Source: Marine Survey, Study Team

6. Prediction of Water Pollution in the Marine Coastal Area

Prediction of turbid water dispersion in the rainy season during the construction phase and the operation phase and diffusion of organic pollutants in the sea during the operation phase were predicted regarding to the conservation of the marine environment. Employed indicator parameters are suspended solids (SS) and chemical oxygen demand(COD) (Table 6-1).

Table 6-1 Case of Water pollution prediction

	Existing Condition	Construction Phase		Operation Phase	
		Without Countermeasures	With Countermeasures	Without Countermeasures	With Countermeasures
SS	○	○	○	○	○
COD	○	-	-	○	○

6.1. Turbid Water Dispersion during Construction Phase

1) Busuanga West

The maximum discharge of soil particle during the construction phase was estimated based on the proposed development plan by this Study assuming both no environmental countermeasures and full-scale countermeasures. The following countermeasures were taken into account:

- No civil engineering works in rainy season
- Road pavement in the proposed construction areas
- Covering the construction areas with grass or sheet in rainy season
- Installation of settling ponds

The amount of SS discharge from the land in the rainy season was estimated by multiplying unit loading value by area of land. Unit load values used in the future condition are shown in Table 6-2. For the existing condition, the field data was employed for estimation of SS discharge to the sea.

Table 6-2 Suspended Solid Unit Load for the Construction Phase

		Unit Load (kg/km ² /d)	Remarks
Without Countermeasures	Bare Land	5,160	Calculated from the field data
	Other than Bare Land	45	Calculated from the field data
With Countermeasures	Bare Land	23	Road pavement, slope protection and installation of settling ponds were taken into account. SS removal rate of 50% was applied for settling ponds.
	Other than Bare Land	45	Calculated from the field data

Measurement of watershed area, construction area (10% of the development area), watershed area other than construction area and existing road area

outside of construction areas are conducted based on the proposed development plan.

The estimated amount of SS discharged into the sea by the watershed area is shown in Table 6-3. Then these amounts of SS discharge were divided by points of inflow, according to the area of the watershed (Table 6-4). Derived SS discharge volume seems to be low compared with that obtained through field measurements in the Okinawa Islands in Japan.

It should be noted that the field data of SS concentration measured as a basis of the calculation of SS unit load were obtained not on rainy days but under fine or cloudy conditions. This might result in an underestimation for SS discharge. According to the mentioned example in Okinawa Island, SS discharge to the sea when there is rain, has become 20 times as high as that when there is no rain.

For the prediction of the turbid water dispersion, Iwai-Inoue's analytical resolution was used.

$$S = \frac{q}{2\pi d \sqrt{K_x K_y}} \exp\left(\frac{xu}{2K_x} - \lambda t\right) K_0 \left\{ \frac{U}{2} \sqrt{\frac{1}{K_x} \left(\frac{x^2}{K_x^2} + \frac{y^2}{K_y^2} \right)} \right\}$$

- where, S: concentration at the location of (x,y) λ : reduction coefficient of pollutant (1/s)
 q: pollutant load (g/s) d: depth of mixing layer (cm)
 U: current velocity (cm/s) t: time(s)
 Kx: diffusion coefficient for x axis (cm²/s) K₀: Bessel function of the second kind
 Ky: diffusion coefficient for y axis (cm²/s)

$$\left[K_0(x) = \int_0^\infty \frac{\exp(-xu)}{\sqrt{u^2 - 1}} du \right]$$

The results of the prediction are shown in Figure 6-1. The dispersion of turbid water decreased the concentration of SS with the distance from the river mouth. The SS concentration in future is likely to be less than that in the present condition, if the proposed countermeasures are implemented.

The precious marine environmental resources, such as coral reefs and seagrass beds are located outside of SS concentration of 1mg/L or more so that these resources will not suffer from the turbid water originated from the proposed development plan.

Table 6-3 Rainy Season SS Discharge Amounts During the Construction Phase, Busuanga

Watershed No.	Watershed Area (m ²)	Development Area (m ²)	Construction Area (m ²)	Watershed Area other than Construction Area (m ²)	Existing Road (m ²)	Road in the Development area (m ²)		Road in the Construction Area (m ²)		Road outside the Construction Area (m ²)	Amount of Suspended Solid (kg/d)		
						Improvement	New	Improvement	New		Existing Condition	without Counter-measures	with Counter-measures
						F	G	H	I		J	K	L
3	12,745,000	58,800	58,480	12,687,520	0	0	0	0	0	0	574	873	572
7	47,744,000	0	0	47,744,000	98,400	0	0	0	0	98,400	2,652	2,652	2,652
8	8,271,000	12,600	1,200	8,269,740	28,350	0	12,600	0	1,200	28,350	517	524	517
9	3,369,000	173,700	17,370	3,350,830	0	0	48,700	0	4,870	0	152	240	151
10	11,617,000	63,600	6,360	11,610,640	49,500	2,010	19,600	201	1,960	49,299	776	807	775
11	29,583,000	195,750	19,575	29,563,425	157,800	7,500	73,100	750	7,310	157,050	2,138	2,235	2,134
12	4,174,000	0	0	4,174,000	33,600	0	0	0	0	33,600	360	360	360
13	192,126,000	1,422,300	142,230	191,983,770	368,850	4,980	357,000	698	35,700	308,152	10,225	10,959	10,219
14	3,673,000	5,000	500	3,672,491	51,000	5,000	0	500	0	53,491	441	441	439

Source: Marine Survey, Study Team

- A Measured on the map
- B Calculated based on the proposed plan
- C B/10 assuming the maximum construction activity
- D A-C
- E Measured road area on the map
- F Measured road area on the map of the proposed plan
- G Measured road area on the map of the proposed plan
- H F/10
- I G/10
- J E-H
- K $E \times 5160 / 1000000 + (A - E) \times 45 / 1000000$
- L $(C + J) \times 5160 / 1000000 + (D - J) \times 45 / 1000000$
- M $J \times 5160 / 1000000 + (D - J) \times 45 / 1000000 + C \times 23 / 1000000$

*see Table 6-2

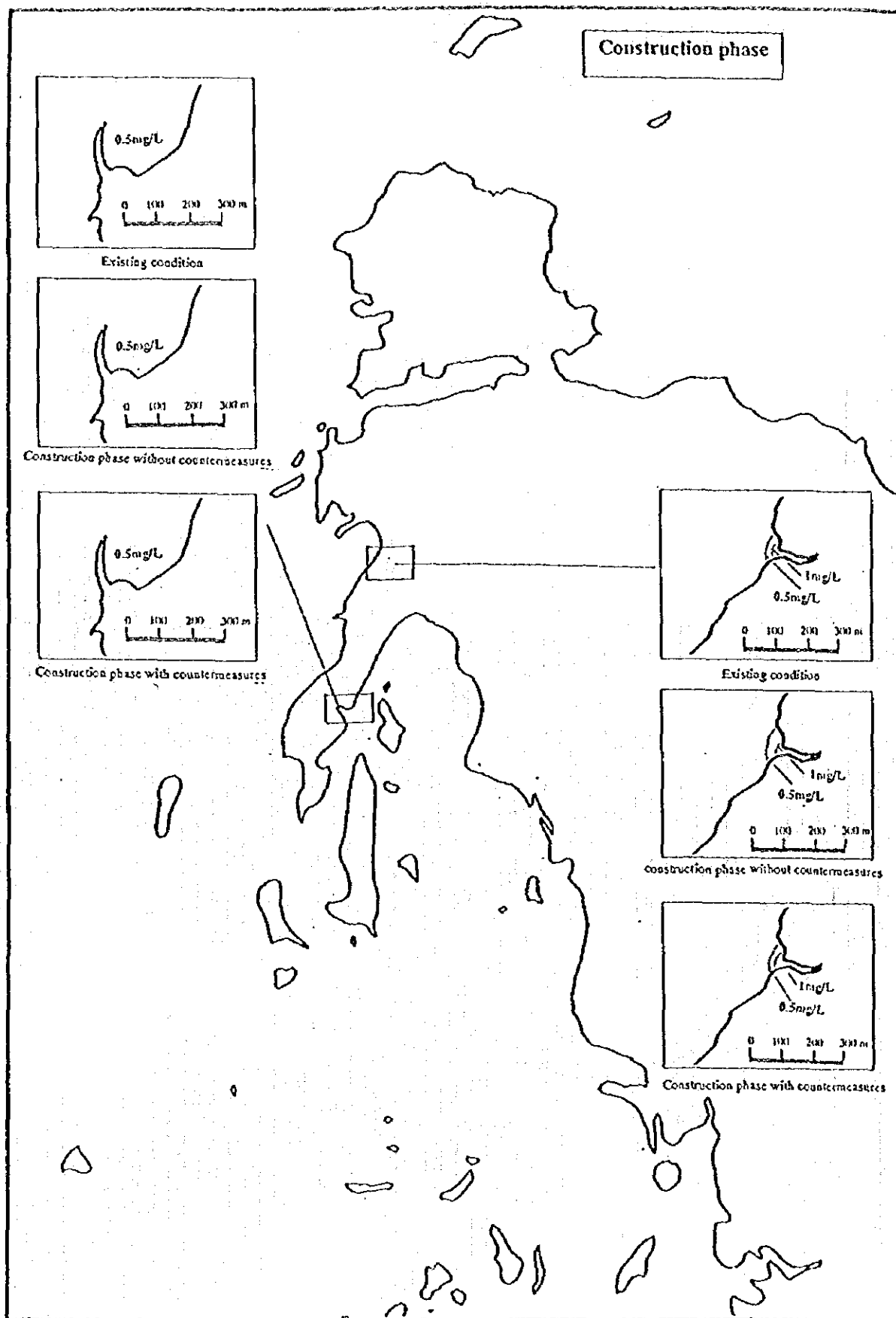
Table 6-4 Estimated SS Discharge to Sea by Watershed Subdivision in the Construction Phase, Busuanga West

Watershed No.	SS Discharge (kg/d)			Change of SS Discharge (kg/d)		Watershed Sub-division No.	Existing SS Discharge (kg/d)	Allocation rate by subdivision	Change of SS Discharge (kg/d)		SS Discharge (kg/d)	
	Existing Condition	without Counter-measures	with Counter-measures	without Counter-measures	with Counter-measures				without Counter-measures	with Counter-measures	without Counter-measures	with Counter-measures
	A	B	C	D	E				F	G	H	I
3	574	873	572	299	-2	3-1	112	0.50	149.50	-1.00	261.5	111.0
						3-2	462	0.50	149.50	-1.00	611.5	461.0
7	2,652	2,652	2,652	0	0	7	2,652	1.00	0.00	0.00	2,652.0	2,652.0
8	517	524	517	7	0	8	517	1.00	7.00	0.00	524.0	517.0
9	152	240	151	88	-1	9	152	1.00	88.00	-1.00	240.0	151.0
10	776	807	775	31	-1	10-1	221	0.50	15.50	-0.50	236.5	220.5
						10-2	99	0.00	0.00	0.00	99.0	99.0
						10-3	456	0.50	15.50	-0.50	471.5	455.5
11	2,138	2,235	2,134	97	-4	11-1	169	0.05	4.85	-0.20	173.9	168.8
						11-2	176	0.15	14.55	-0.60	190.6	175.4
						11-3	165	0.20	19.40	-0.80	184.4	164.2
						11-4	62	0.00	0.00	0.00	62.0	62.0
						11-5	20	0.00	0.00	0.00	20.0	20.0
						11-6	609	0.00	0.00	0.00	609.0	609.0
						11-7	385	0.00	0.00	0.00	385.0	385.0
						11-8	167	0.00	0.00	0.00	167.0	167.0
						11-9	44	0.00	0.00	0.00	44.0	44.0
						11-10	341	0.00	58.20	-2.40	399.2	338.6
12	360	360	360	0	0	12-1	7	0.00	0.00	0.00	7.0	7.0
						12-2	13	0.00	0.00	0.00	13.0	13.0
						12-3	24	0.00	0.00	0.00	24.0	24.0
						12-4	5	0.00	0.00	0.00	5.0	5.0
						12-5	61	0.00	0.00	0.00	61.0	61.0
						12-6	250	0.00	0.00	0.00	250.0	250.0
13	10,225	10,949	10,219	724	-6	13	10,225	1.00	724.00	-6.00	10,949.0	10,219.0
14	441	441	439	0	-2	14	441	1.00	0.00	-2.00	441.0	439.0

Source: Marine Survey, Study Team

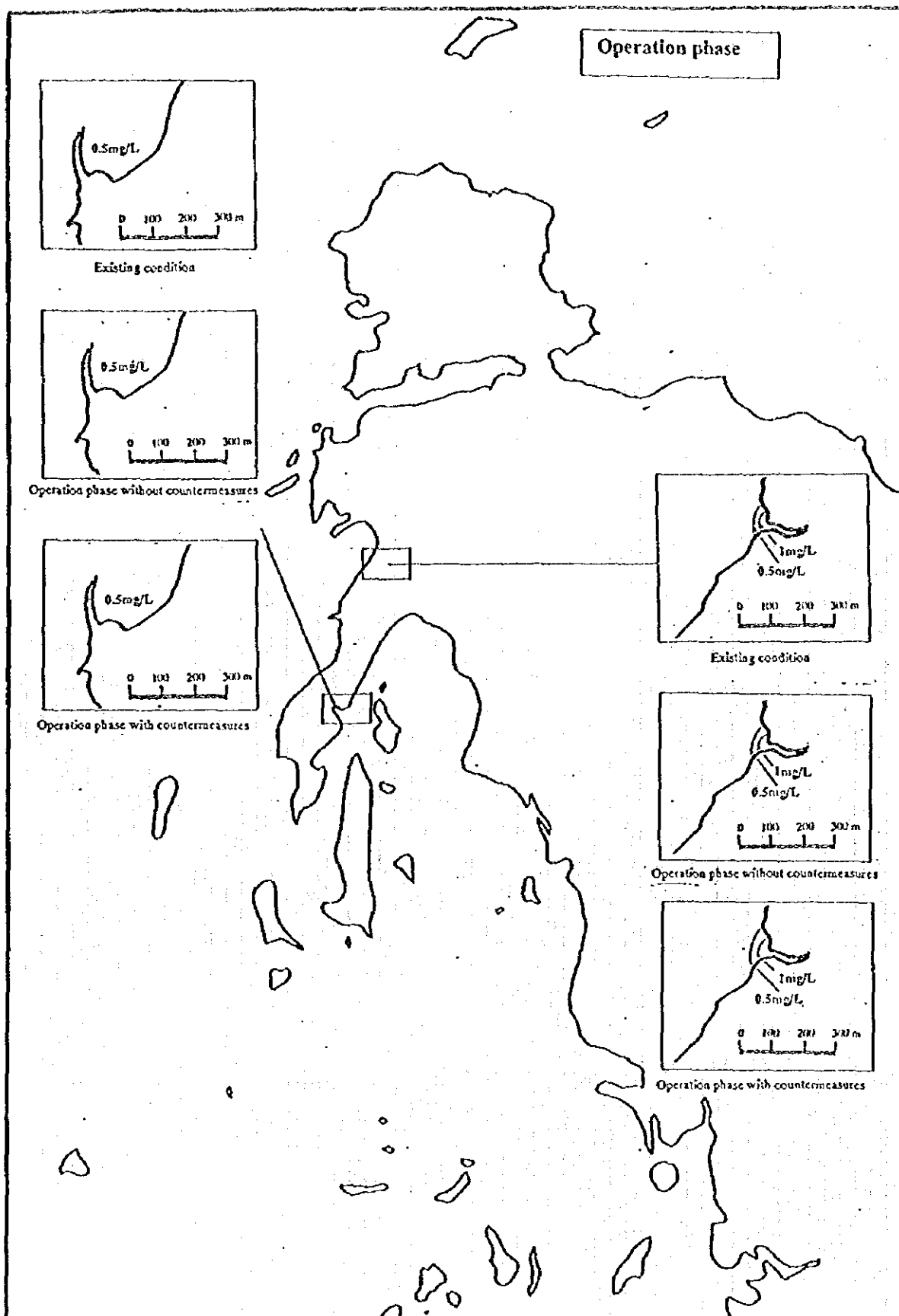
- A See Table 6-3, K
- B See Table 6-3, L
- C See Table 6-3, M
- D B-A
- E C-A
- F Allocation of A based on sub-divisional watershed area
- G Assumed based on the proposed plan
- H D×G
- I E×G
- J F+H
- K F+I

Figure 6-1 Distribution of SS Concentration During Construction Phase, Busuanga West



Source: Marine Survey, Study Team

Figure 6-2 Distribution of SS Concentration During Operation Phase, Busuanga West



Source: Marine Survey, Study Team

2) El Nido

The same analysis as for Busuanga West was done for El Nido. Table 6-5 shows the estimated amount of SS discharge into the sea by watershed. Provided that all countermeasures proposed in this Study are implemented, the SS load should decrease.

The dispersion of SS concentration was also predicted the same way as for Busuanga West. The implementation of the proposed project will not cause further problems concerning turbid water dispersion.

Table 6-5 Rainy Season SS Discharged Amount Into the Sea During Construction Phase, El Nido

Watershed No.	Watershed Area (m ²)	Developed Area (m ²)	Construction Area (m ²)	Watershed Area other than Construction Area (m ²)	Existing Road (m ²)	Road in the Development area (m ²)		Road in the Construction Area (m ²)		Road outside of the Construction Area (m ²)	Amount of Suspended Solid (kg/d)		
						Improvement	New	Improvement	New		Existing Condition	without Counter-measures	with Counter-measures
1	18,437,000	1,029,400	102,940	18,334,060	0	0	59,300	0	5,930	0	830	1,356	827
3	86,589,000	559,700	55,970	86,533,030	127,800	11,620	130,200	1,162	13,020	126,638	4,550	4,833	4,543
5	35,120,000	6,310	631	35,119,369	92,350	6,110	0	611	0	91,639	2,052	2,052	2,049
6	2,898,000	1,390	139	2,897,861	10,350	1,390	0	139	0	10,211	183	183	183
7	26,315,000	1,007,700	100,770	26,214,230	120,750	7,060	0	706	0	120,044	1,802	2,314	1,796
8	24,385,000	287,100	28,710	24,357,290	114,450	0	0	0	0	114,450	1,683	1,830	1,682
9	38,372,000	0	0	38,372,000	54,000	0	0	0	0	54,000	2,003	2,003	2,003
10	36,714,000	0	0	36,714,000	31,950	0	0	0	0	31,950	1,816	1,816	1,816

Source: Marine Survey, Study Team

- A Measured on the map
- B Calculated based on the proposed plan
- C B/10 assuming the maximum construction activity
- D A-C
- E Measured road area on the map
- F Measured road area on the map of the proposed plan
- G Measured road area on the map of the proposed plan
- H F/10
- I G/10
- J E-H
- K $E \times 5160 / 1000000 + (A - E) \times 45 / 1000000$
- L $(C + J) \times 5160 / 1000000 + (D - J) \times 45 / 1000000$
- M $J \times 5160 / 1000000 + (D - J) \times 45 / 1000000 + C \times 23 / 1000000$

*see Table 6-2

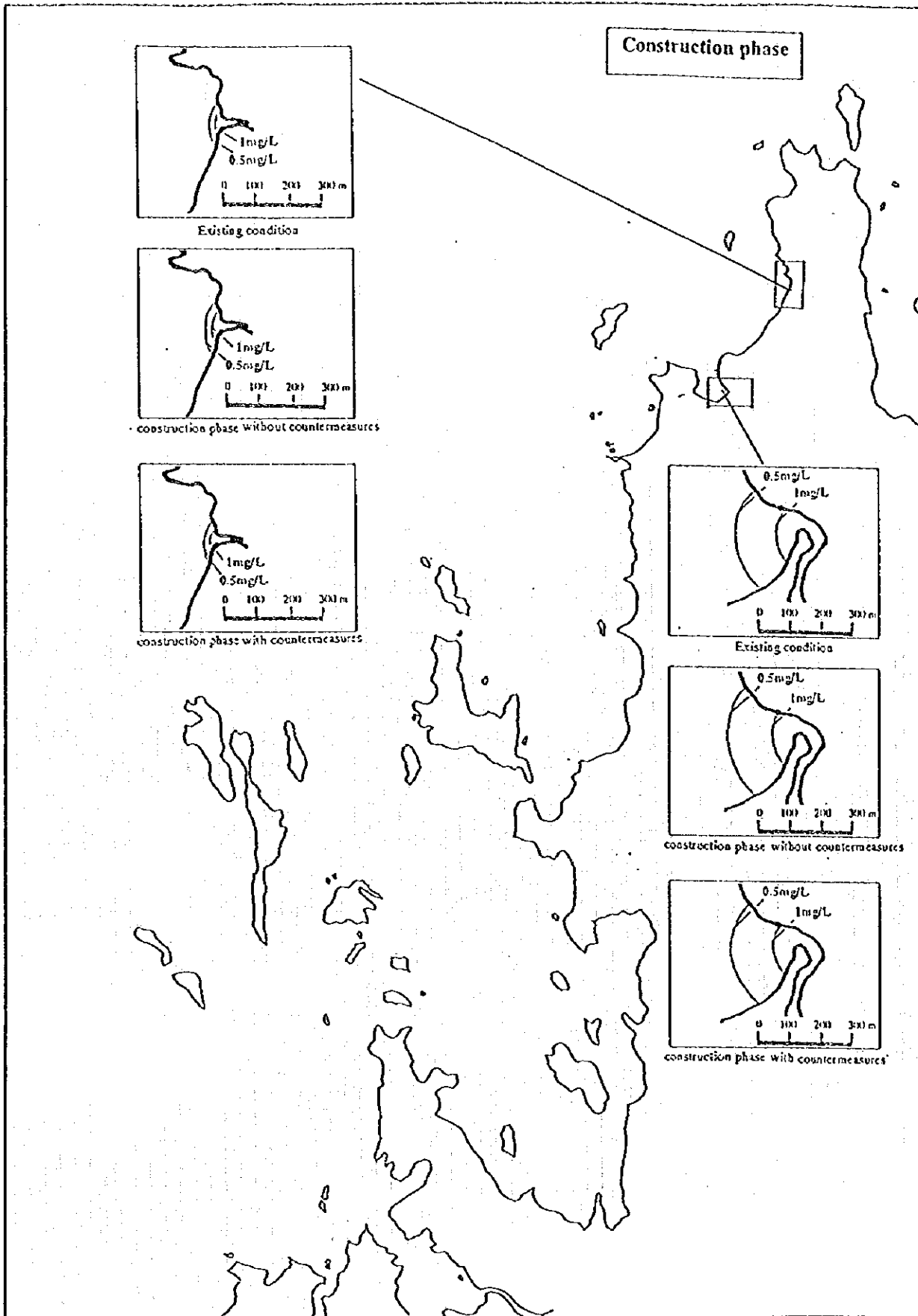
Table 6-6 Estimated SS Discharge to the Sea by Watershed Subdivision in the Construction Phase, El Nido

Watershed No.	SS Discharge (kg/d)			Change of SS Discharge (kg/d)			Watershed Subdivision No.	Existing SS Discharge (kg/d)	Allocation rate by sub-division	Change of SS Discharge (kg/d)		SS Discharge (kg/d)	
	Existing Condition	without Counter-measures	with Counter-measures	without Counter-measures	with Counter-measures	without Counter-measures				with Counter-measures	without Counter-measures	with Counter-measures	
													A
1	830	1,356	823	526	-3	1-1	479	0.50	263.00	-1.50	742.0	477.5	
						1-2	351	0.50	263.00	-1.50	614.0	349.5	
3	4,550	4,831	4,543	281	-7	3-1	210	0.00	0.00	0.00	210.0	210.0	
						3-2	4,340	1.00	281.00	-7.00	4,621.0	4,333.0	
5	2,052	2,052	2,049	0	-3	5	2,052	1.00	0.00	-3.00	2,052.0	2,049.0	
6	183	183	183	0	0	6-1	102	0.50	0.00	0.00	102.0	102.0	
						6-2	81	0.50	0.00	0.00	81.0	81.0	
7	1,802	2,314	1,796	512	-6	7	1,802	1.00	512.00	-6.00	2,314.0	1,296.0	
8	1,683	1,830	1,682	141	-1	8-1	201	0.20	29.40	-0.20	230.4	200.8	
						8-2	552	0.20	29.40	-0.20	581.4	551.8	
						8-3	40	0.20	29.40	-0.20	69.4	39.8	
						8-4	250	0.20	29.40	-0.20	279.4	249.8	
						8-5	640	0.20	29.40	-0.20	669.4	639.8	
9	2,003	2,003	2,003	0	0	9-1	976	0.50	0.00	0.00	976.0	976.0	
						9-2	81	0.50	0.00	0.00	81.0	81.0	
						9-3	936	0.00	0.00	0.00	946.0	946.0	
10	1,816	1,816	1,816	0	0	10-1	1613	0.00	0.00	0.00	1,613.0	1,613.0	
						10-2	203	0.00	0.00	0.00	203.0	203.0	

Source: Marine Survey, Study Team

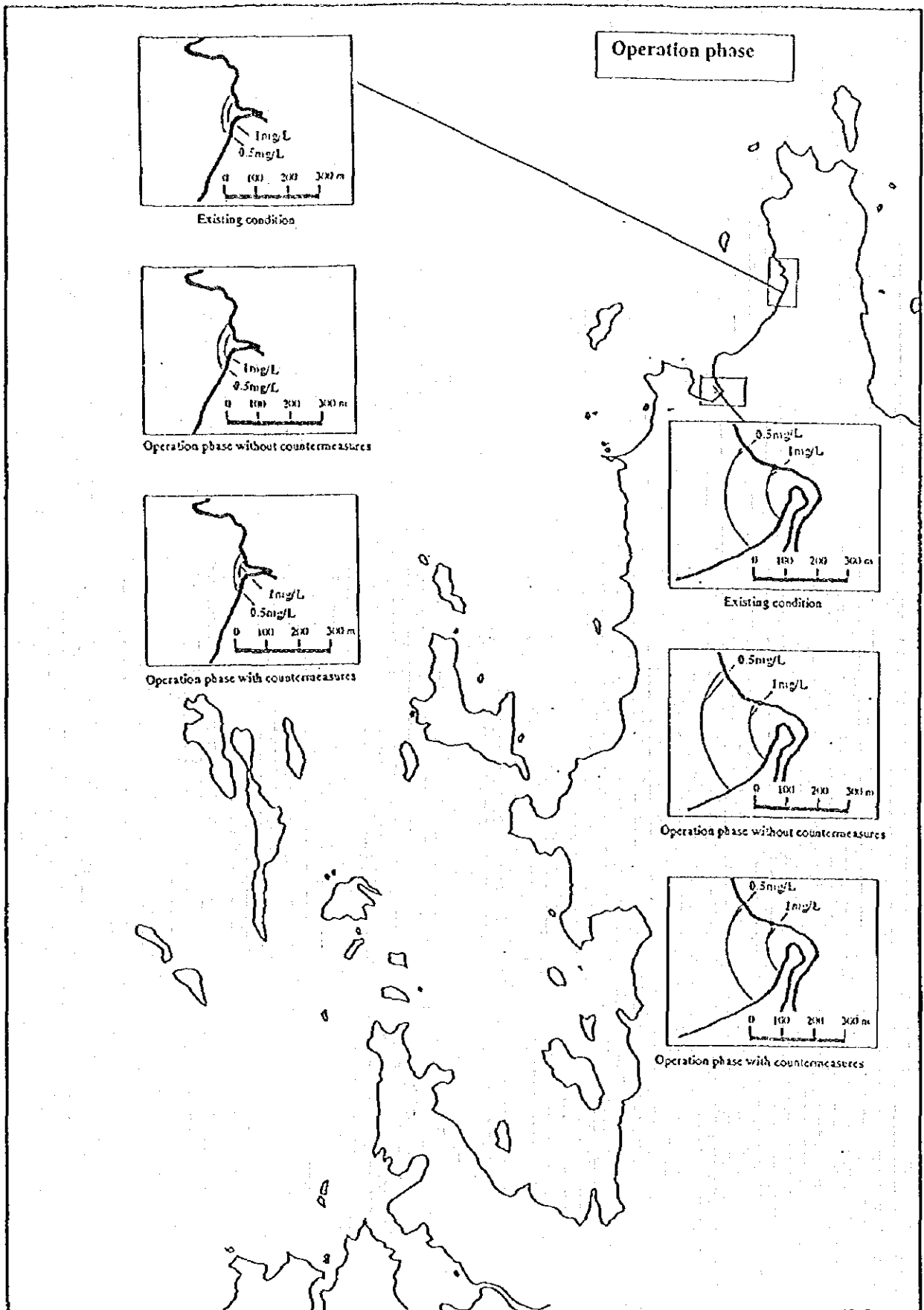
- A See Table 6-5, K
- B See Table 6-5, L
- C See Table 6-5, M
- D B-A
- E C-A
- F Allocation of A based on sub-divisional watershed area
- G Assumed based on the proposed plan
- H D×G
- I E×G
- J F+H
- K F+I

Figure 6-3 Distribution of SS Concentration During Construction Phase, El Nido North



Source: Marine Survey, Study Team

Figure 6-4 Distribution of SS Concentration During Operation Phase, El Nido North



Source: Marine Survey, Study Team

6.2. Turbid Water Dispersion during Operation Phase

1) Busuanga West

The amount of discharge of soil particles during the operation phase was estimated based on the proposed development plan assuming both no environmental countermeasures and full-scale countermeasures. The countermeasures are shown below:

- Pavement of all road in the development area
- Implementation of slope protection
- Installation of settling ponds
- SS unit load is cited in Table 6-7.

Table 6-7 SS Unit Load for the Operation Phase

		Unit Load (kg/km ² /day)	Remarks
without Countermeasures	Road outside of the Development Area	5,160	Calculated from the field data
	Road in the Development Area	5,160	Calculated from the field data
	Other Development Area	270	Derived from existing data
	Others	45	Calculated from the field data
with Countermeasures	Road outside of the Development Area	5160	Calculated from the field data
	Road in the Development Area	23	Road pavement, slope protection and installation of settling ponds were taken into account. SS removal rate of 50% was applied for settling ponds
	Other Development Area	23	Road pavement, slope protection and installation of settling ponds were taken into account. SS removal rate of 50% was applied for settling ponds
	Others	45	Calculated from the field data

Source: Marine Survey, Study Team

The estimated amount of SS discharge into the sea by watershed is shown in Table 6-8 and 6-9. For the prediction of turbid water dispersion, Iwai-Inoue's resolution was employed, which was applied for SS dispersion in the construction phase. The result of prediction are shown in Figure 6-5 and 6-6. These show that the adverse impact from the operation of proposed facilities in future can not be seen regarding to the existing marine environmental resources.

Table 6-8 Rainy Season SS Amount During Operation Phase, Busuanga West

Watershed No.	Watershed Area (m ²)	Existing Road (m ²)	Development Area (m ²)					Non-Development Area (m ²)		Amount of Suspended Solid (kg/d)		
			Road			Others	Total	Road	Others	Existing Condition	without Counter-measures	with Counter-measures
			Improvement	New	Total							
						A	B	C	D	E	F	G
3	12,746,000	0	0	0	0	584,800	584,800	0	12,161,200	574	705	561
7	47,744,000	98,400	0	0	0	0	0	98,400	47,645,600	2,652	2,652	2,652
8	8,271,000	28,350	0	12,600	12,600	0	12,600	28,350	8,230,050	517	582	517
9	3,368,000	0	0	48,700	48,700	125,000	173,700	0	3,194,300	152	429	148
10	11,617,000	49,500	2,010	19,600	21,610	41,990	63,600	47,490	11,505,910	776	886	764
11	29,583,000	157,800	7,500	73,100	80,600	115,150	195,750	150,300	29,236,950	2,138	2,538	2,096
12	4,174,000	33,600	0	0	0	0	0	33,600	4,140,400	360	360	360
13	192,126,000	308,850	6,980	357,000	363,980	1,058,320	1,422,300	301,870	190,401,830	10,225	12,290	10,158
14	3,673,000	54,000	5,090	0	5,090	0	5,090	48,910	3,619,000	441	441	415

Source: Marine Survey, Study Team

- A Measured on the map
- B Measured the road area on the map
- C Measured the road area on the map of the proposed plan
- D Measured the road area on the map of the proposed plan
- E C+D
- F Calculated based on the proposed plan
- G E+F
- H B-C
- I A-G-H
- J See Table 6-3, K
- K $(E+H) \times 5160 / 1000000 + F \times 270 / 1000000 + I \times 45 / 1000000$
- L $H \times 5160 / 1000000 + G \times 23 / 1000000 + I \times 45 / 1000000$

*see Table 6-2

Table 6-9 Estimated SS Discharge to the Sea by Watershed Subdivision During Operation Phase, Busuanga West

Watershed No.	SS Discharge (kg/d)			Change of SS Discharge (kg/d)		Watershed Sub-division No	Existing SS Discharge (kg/d)	Allocation rate by sub-division	Change of SS Discharge (kg/d)		SS Discharge (kg/d)	
	Existing	without	with	without	with				without	with	Counter-measures	Counter-measures
	Condition	Counter-measures	Counter-measures	Counter-measures	Counter-measures							
A	B	C	D	E	F	G	H	I	J	K		
3	574	705	561	131	-13	3-1	112	0.50	65.50	-6.50	177.5	105.5
						3-2	462	0.50	65.50	-6.50	527.5	455.5
7	2,652	2,652	2,652	0	0	7	2,652	1.00	0.00	0.00	2,652.0	2,652.0
8	517	582	517	65	0	8	517	1.00	65.00	0.00	582.0	517.0
9	152	429	148	277	-4	9	152	1.00	277.00	-4.00	429.0	148.0
10	776	886	764	110	-12	10-1	221	0.50	55.00	-6.00	276.0	215.0
						10-2	99	0.00	0.00	0.00	99.0	99.0
						10-3	456	0.50	55.00	-6.00	511.0	450.0
11	2,138	2,538	2,096	400	-42	11-1	169	0.05	20.00	-2.10	189.0	166.9
						11-2	176	0.15	60.00	-6.30	236.0	169.7
						11-3	165	0.20	80.00	-8.40	245.0	156.6
						11-4	62	0.00	0.00	0.00	62.0	62.0
						11-5	20	0.00	0.00	0.00	20.0	20.0
						11-6	609	0.00	0.00	0.00	609.0	609.0
						11-7	385	0.00	0.00	0.00	385.0	385.0
						11-8	167	0.00	0.00	0.00	167.0	167.0
						11-9	44	0.00	0.00	0.00	44.0	44.0
						11-10	341	0.60	240.00	-25.20	581.0	315.8
12	360	360	360	0	0	12-1	7	0.00	0.00	0.00	7.0	7.0
						12-2	13	0.00	0.00	0.00	13.0	13.0
						12-3	24	0.00	0.00	0.00	24.0	24.0
						12-4	5	0.00	0.00	0.00	5.0	5.0
						12-5	61	0.00	0.00	0.00	61.0	61.0
						12-6	250	0.00	0.00	0.00	250.0	250.0
13	10,225	12,290	10,158	2,065	-67	13	10,225	1.00	2,065.00	-67.00	12,290.0	10,158.0
14	441	441	415	0	-26	14	441	1.00	0.00	-26.00	441.0	415.0

Source: Marine Survey, Study Team

- A See Table 6-8, J
- B See Table 6-8, K
- C See Table 6-8, L
- D B-A
- E C-A
- F Derived from A dividing based on the extent of watershed subdivision
- G Estimated based on the proposed development plan
- H D×G
- I E×G
- J F+H
- K F+I

Figure 6-5a Distribution of SS Concentration in Sub-block B. 10-3
Buluang, Busuanga West

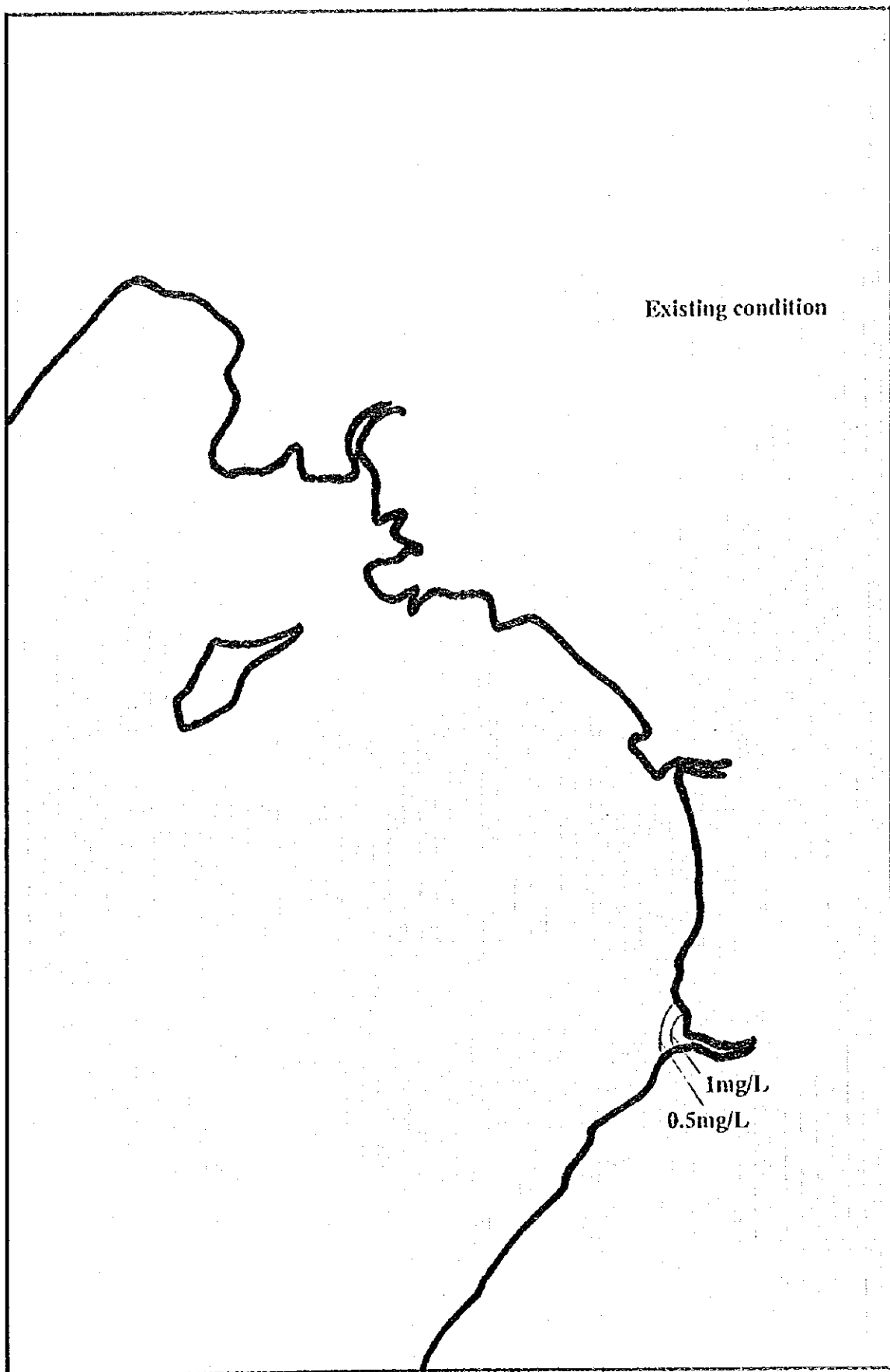


Figure 6-5b Distribution of SS Concentration Sub-block B. 10-3,
Buluang, Busuanga West

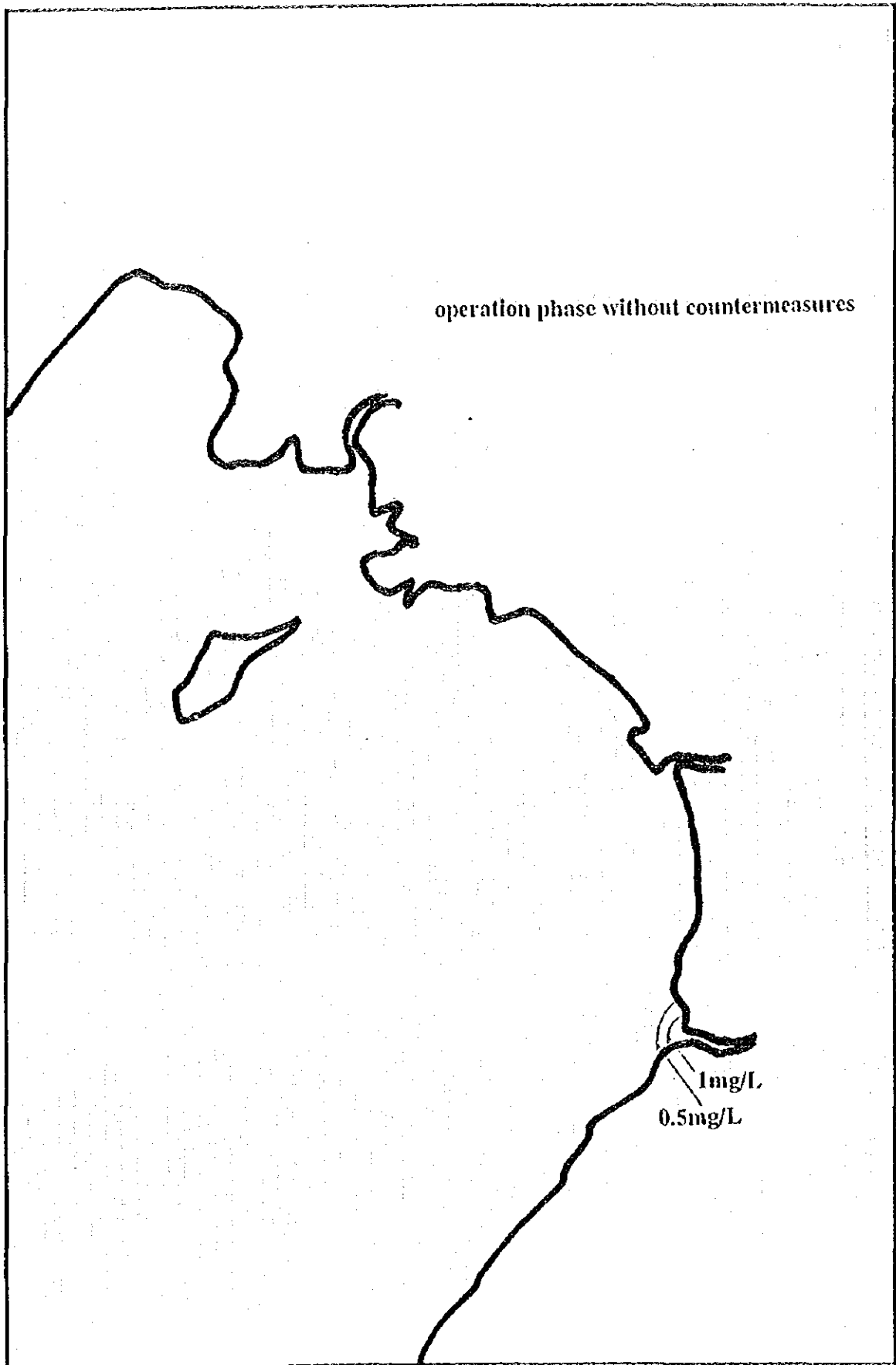


Figure 6-5c Distribution of SS Concentration Sub-block B. 10-3,
Buluang, Busuanga West

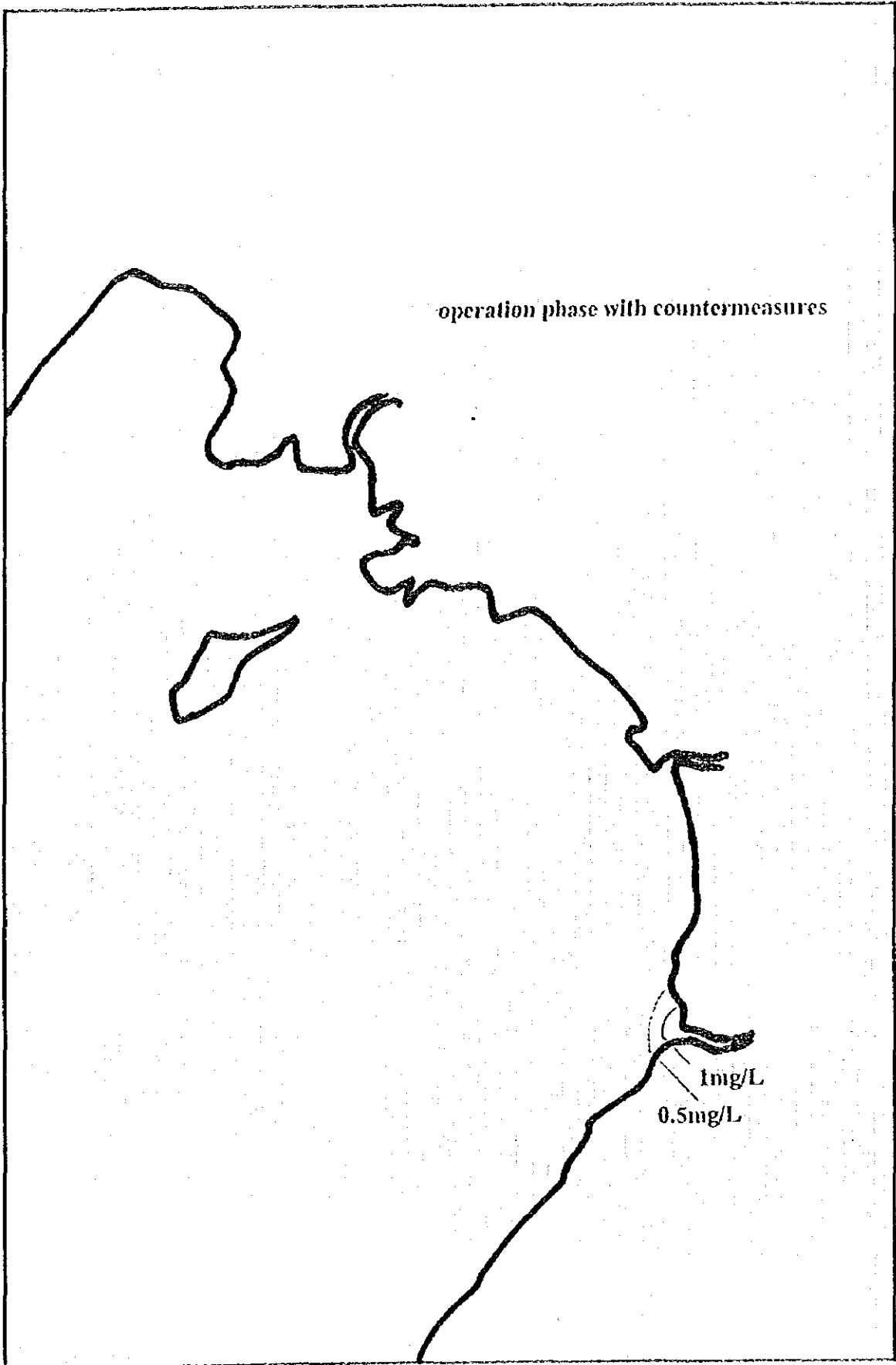
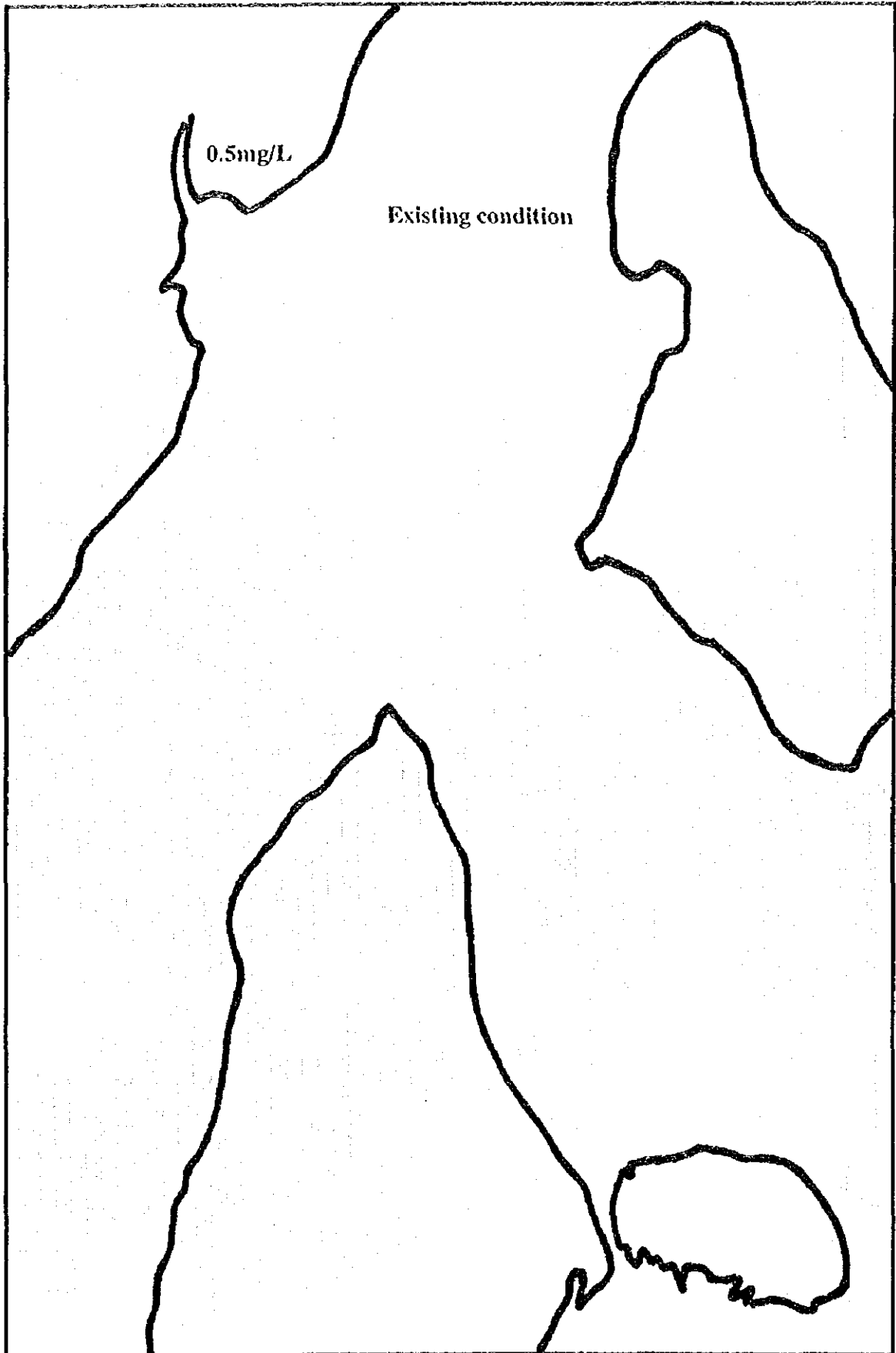


Figure 6-6a Distribution of SS Concentration Sub-block B. 11-2,
Gutob Anchorage, Busuanga West



Source: Marine Survey, Study Team

Figure 6-6b Distribution of SS Concentration Sub-block B. 11-2,
Gutob Anchorage, Busuanga West

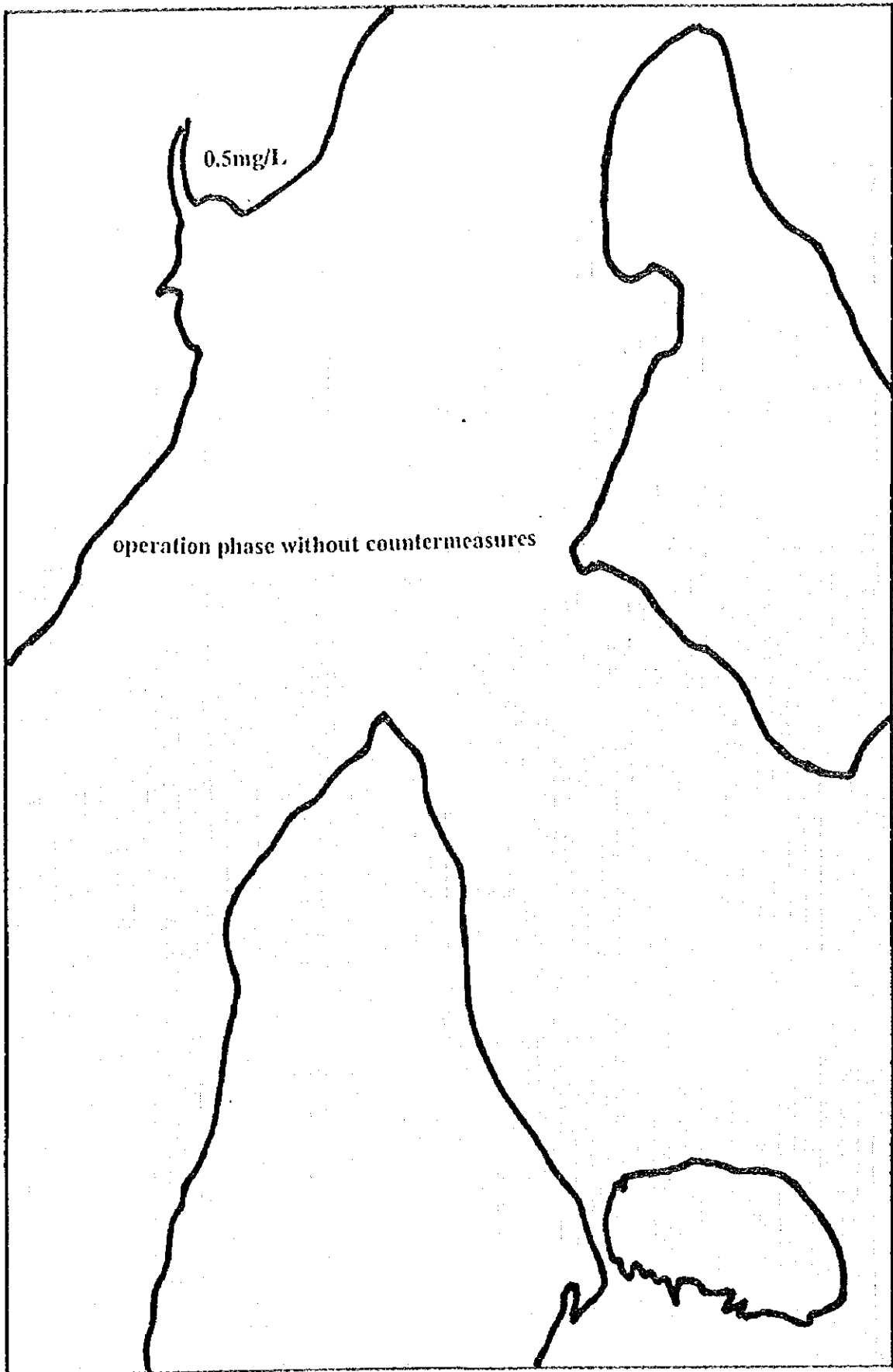
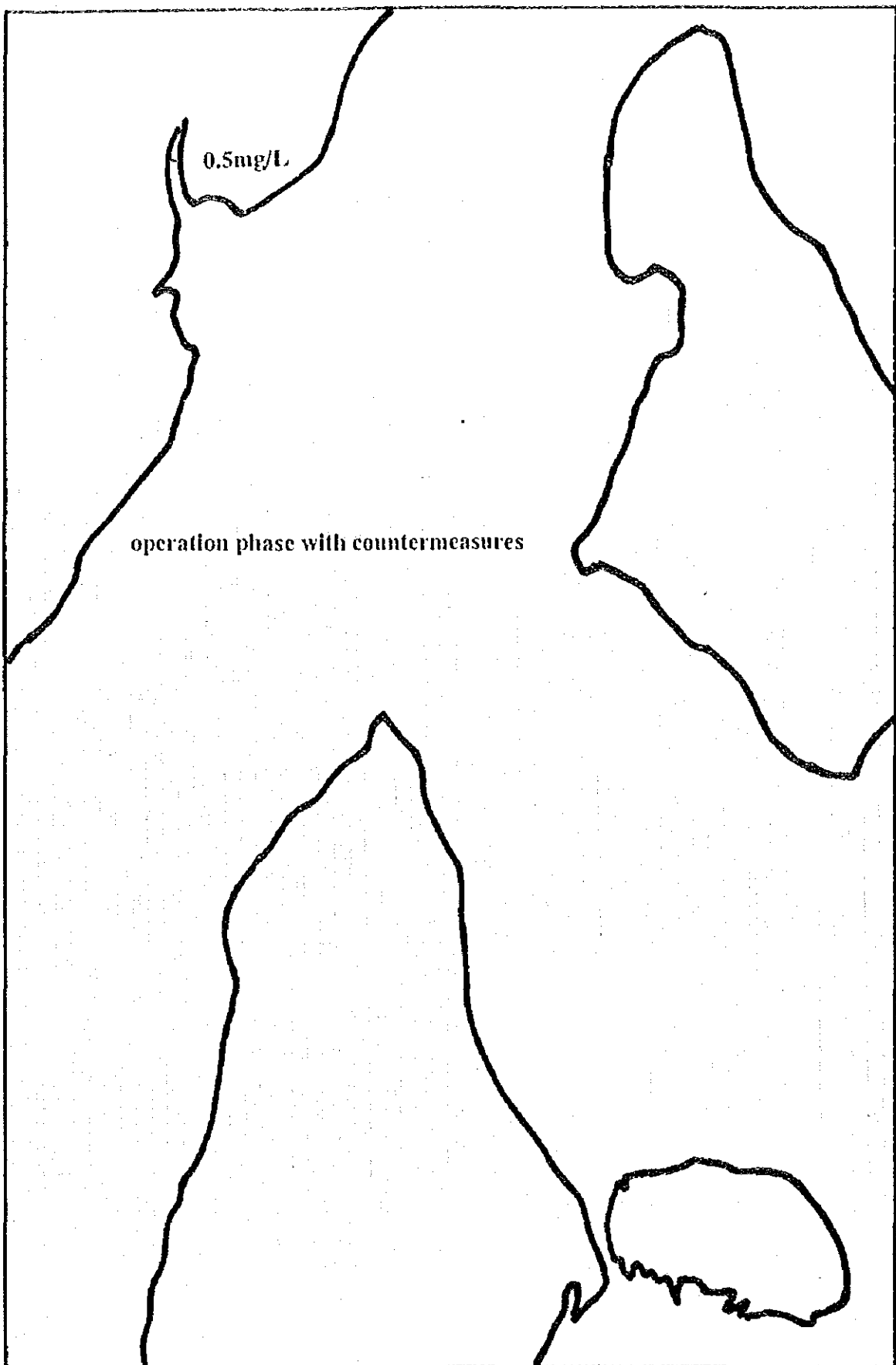


Figure 6-6c Distribution of SS Concentration Sub-block B. 11-2,
Gutob Anchorage, Busuanga West



Source: Marine Survey, Study Team

2) El Nido

The same analysis as for Busuanga West was done for El Nido. Table 6-10 and 6-11 show the amount of SS discharge to the sea. It is clear that the implementation of full-scale countermeasures decrease the SS discharge to the sea during the operation phase. The dispersion of SS concentration was predicted using Iwai-Inoue's resolution. Results show that SS dispersion in the operation phase will not cause more significant adverse effects if the countermeasures proposed by this Study are executed(Figure6-7).

Table 6-10 Amount of suspended solid during operation phase in rainy season in El Nido

Watershed No.	Watershed Area (m ²)	Existing Road (m ²)	Development Area (m ²)					Non-Development Area (m ²)		Amount of Suspended Solid (kg/d)		
			Road			Others	Total	Road	Others	Existing Condition	without Countermeasures	with Countermeasures
			Improvement	New	Total							
						A	B	C	D	E	F	G
1	18,437,000	0	0	59,300	59,300	970,100	1,029,400	0	17,407,600	830	1,351	807
3	86,559,000	127,800	116,200	130,200	141,820	417,880	559,700	116,180	85,913,120	4,550	5,310	4,478
5	35,120,000	92,250	6,110	0	6,110	200	6,310	86,140	35,027,550	2,052	2,052	2,021
6	2,898,000	10,350	1,390	0	1,390	0	1,390	8,960	2,887,650	183	183	176
7	26,315,000	120,750	7060	0	7,060	1,000,640	1,007,700	113,690	25,193,610	1,802	2,027	1,744
8	24,386,000	114,450	0	0	0	287,100	287,100	114,450	23,984,450	1,683	1,747	1,676
9	38,372,000	54,000	0	0	0	0	0	54,000	38,318,000	2,003	2,003	2,003
10	36,714,000	31,950	0	0	0	0	0	31,950	36,682,050	1,816	1,816	1,816

Source: Marine Survey, Study Team

- A Measured on the map
- B Measured the road area on the map
- C Measured the road area on the map of the proposed plan
- D Measured the road area on the map of the proposed plan
- E C+D
- F Calculated based on the proposed plan
- G E+F
- H B-C
- I A-G-H
- J See Table 6-5, K
- K $(E+H) \times 5160 / 1000000 + F \times 270 / 1000000 + I \times 45 / 1000000$
- L $H \times 5160 / 1000000 + G \times 23 / 1000000 + I \times 45 / 1000000$

*see Table 6-2

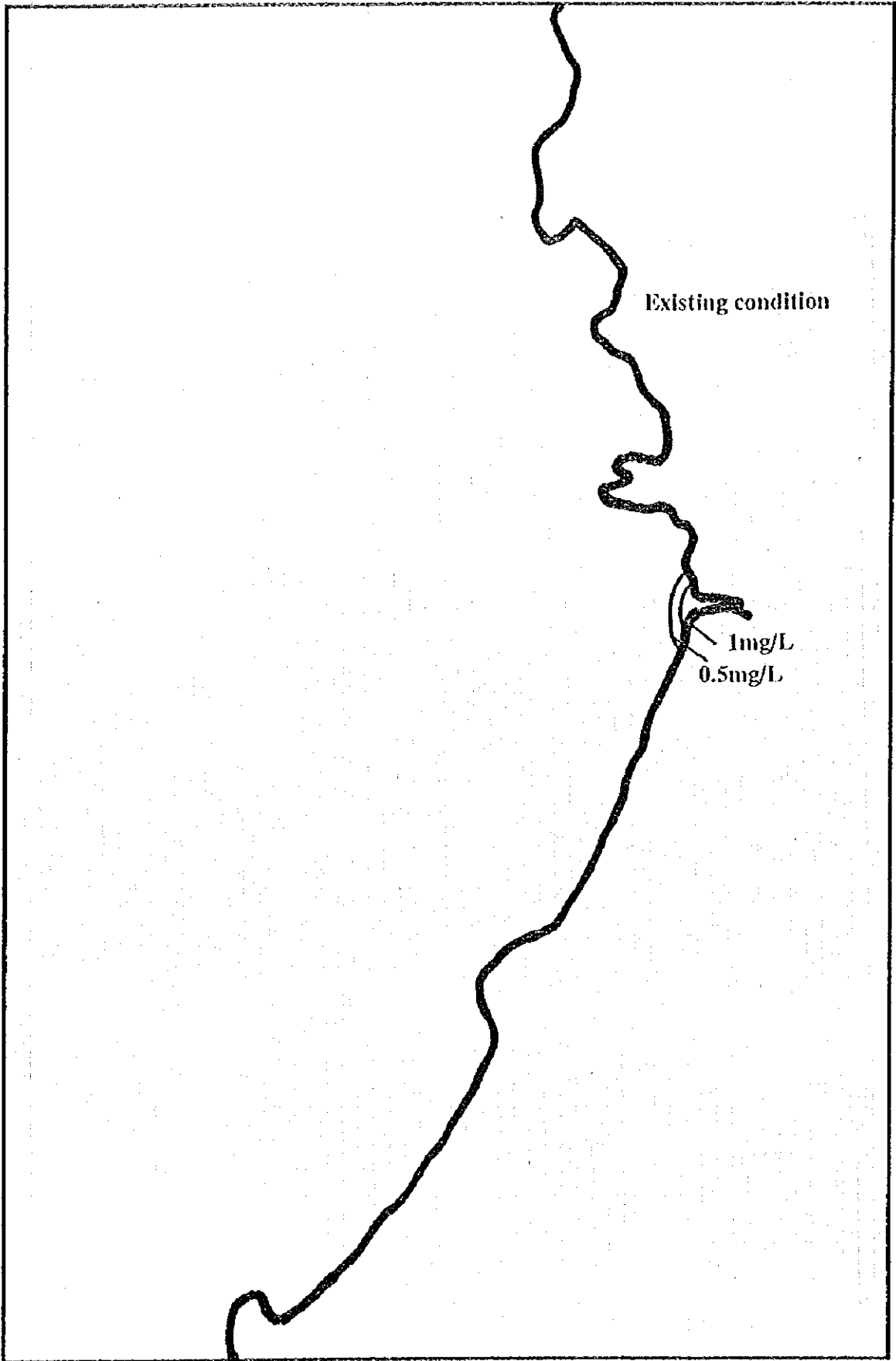
Table 6-11 Estimated SS Discharge to the Sea by Watershed Subdivision During Operation Phase, El Nido

Water-shed No.	SS Discharge (kg/d)			Change of SS Discharge (kg/d)		Watershed Sub-division No.	Existing SS Discharge (kg/d)	Allocation rate by sub-division	Change of SS Discharge (kg/d)		SS Discharge (kg/d)	
	Existing Condition	without Counter-measures	with Counter-measures	without Counter-measures	with Counter-measures				without Counter-measures	with Counter-measures	without Counter-measures	with Counter-measures
	A	B	C	D	E				F	G	H	I
1	830	1,351	807	521	-23	1-1	479	0.50	260.50	-11.50	739.5	467.5
						1-2	351	0.50	260.50	-11.50	611.5	339.5
3	4,550	5,310	4,478	760	-72	3-1	210	0.00	0.00	0.00	210.0	210.0
						3-2	4,340	1.00	760.00	-72.00	5,100.0	4,268.0
5	2,052	2,052	2,021	0	-31	5	2,052	1.00	0.00	-31.00	2,052.0	2,021.0
6	183	183	176	0	-7	6-1	102	0.50	0.00	-3.50	102.0	98.5
						6-2	81	0.50	0.00	-3.50	81.0	77.5
7	1,802	2,027	1,744	225	-58	7	1,802	1.00	225.00	-58.00	2,027.0	1,744.0
8	1,683	1,747	1,676	64	-7	8-1	201	0.20	12.80	-1.40	213.8	199.6
						8-2	552	0.20	12.80	-1.40	564.8	550.6
						8-3	40	0.20	12.80	-1.40	52.8	38.6
						8-4	250	0.20	12.80	-1.40	262.8	248.6
						8-5	640	0.20	12.80	-1.40	652.8	638.6
9	2,003	2,003	2,003	0	0	9-1	976	0.50	0.00	0.00	976.0	976.0
						9-2	81	0.50	0.00	0.00	81.0	81.0
						9-3	946	0.00	0.00	0.00	946.0	946.0
10	1,816	1,816	1,816	0	0	10-1	1,613	0.00	0.00	0.00	1,613.0	1,613.0
						10-2	203	0.00	0.00	0.00	203.0	203.0

Source: Marine Survey, Study Team

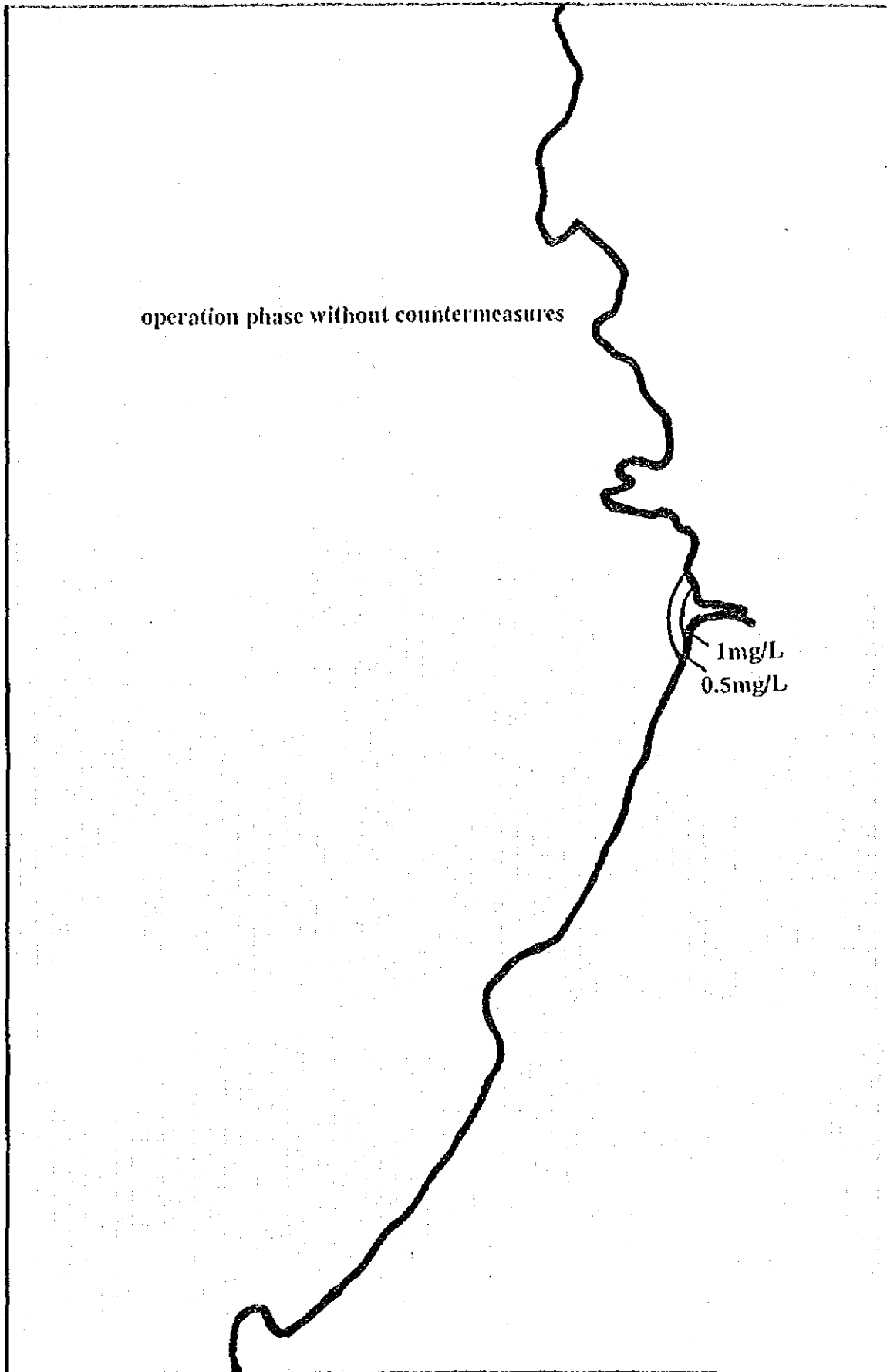
- A See Table 6-10, J
- B See Table 6-10, K
- C See Table 6-10, L
- D B-A
- E C-A
- F Derived from A dividing based on the extent of watershed subdivision
- G Estimated based on the proposed development plan
- H D×G
- I E×G
- J F+H
- K F+I

Figure 6-7a Distribution of SS Concentration, Sub-block E. 1-1 Dagmay Point, El Nido



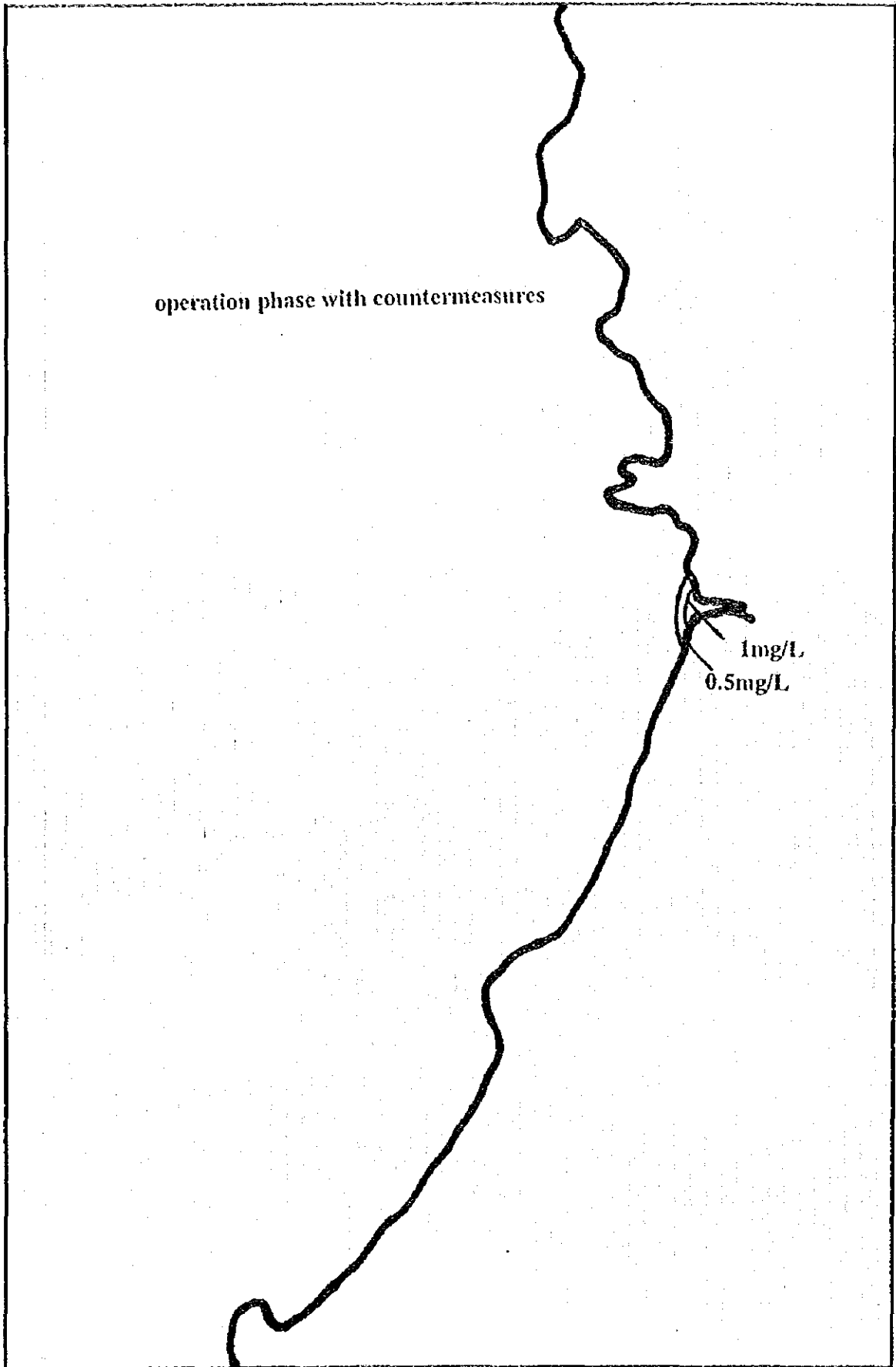
Source: Marine Survey, Study Team

Figure 6-7b Distribution of SS Concentration, Sub-block E. 1-1 Dagmay Point, El Nido



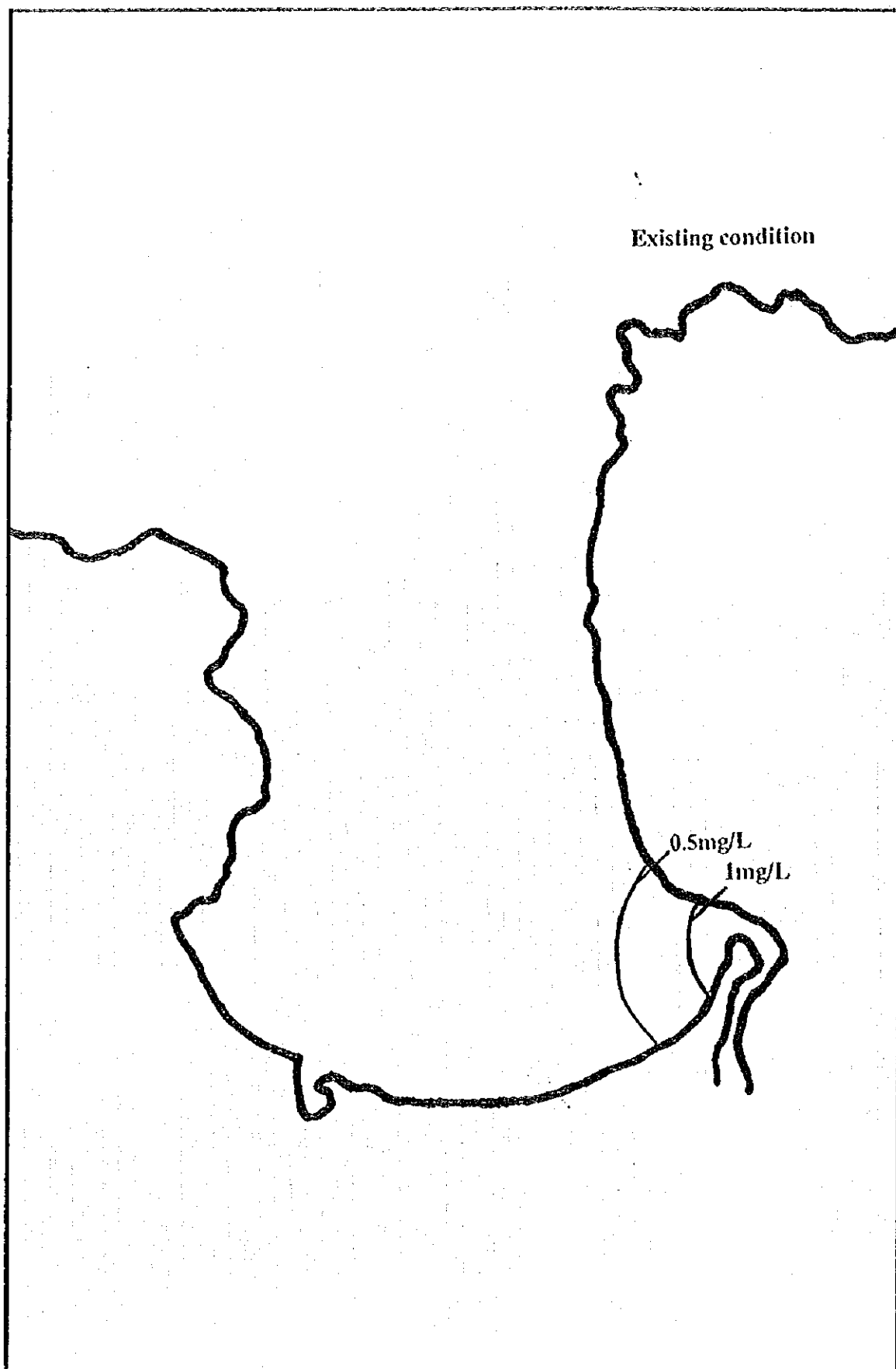
Source: Marine Survey, Study Team

Figure 6-7c Distribution of SS Concentration, Sub-block E. 1-1 Dagmay Point, El Nido



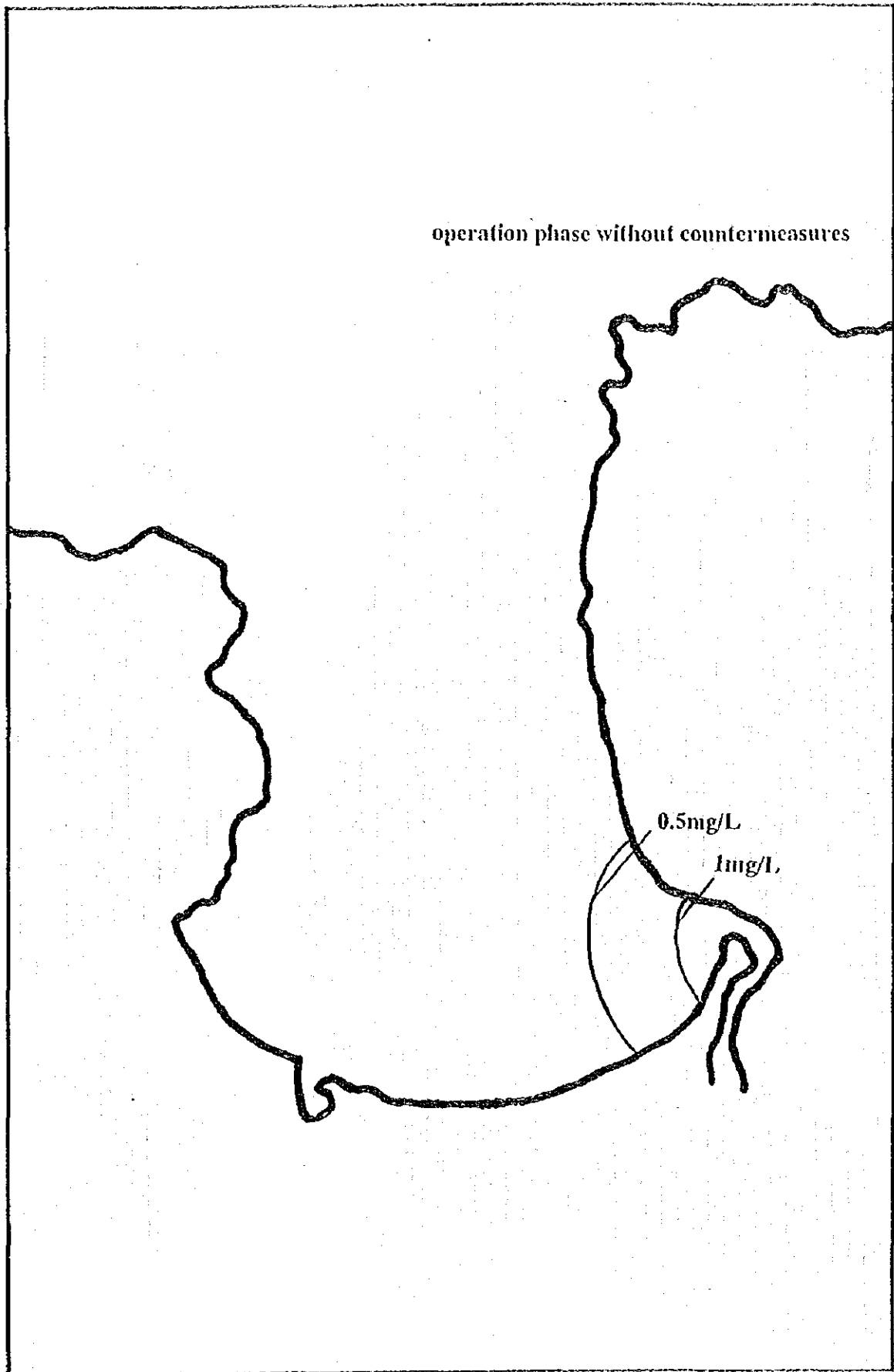
Source: Marine Survey, Study Team

Figure 6-8a Distribution of SS Concentration, Sub-block E. 3-2 Yokoton Bay, El Nido



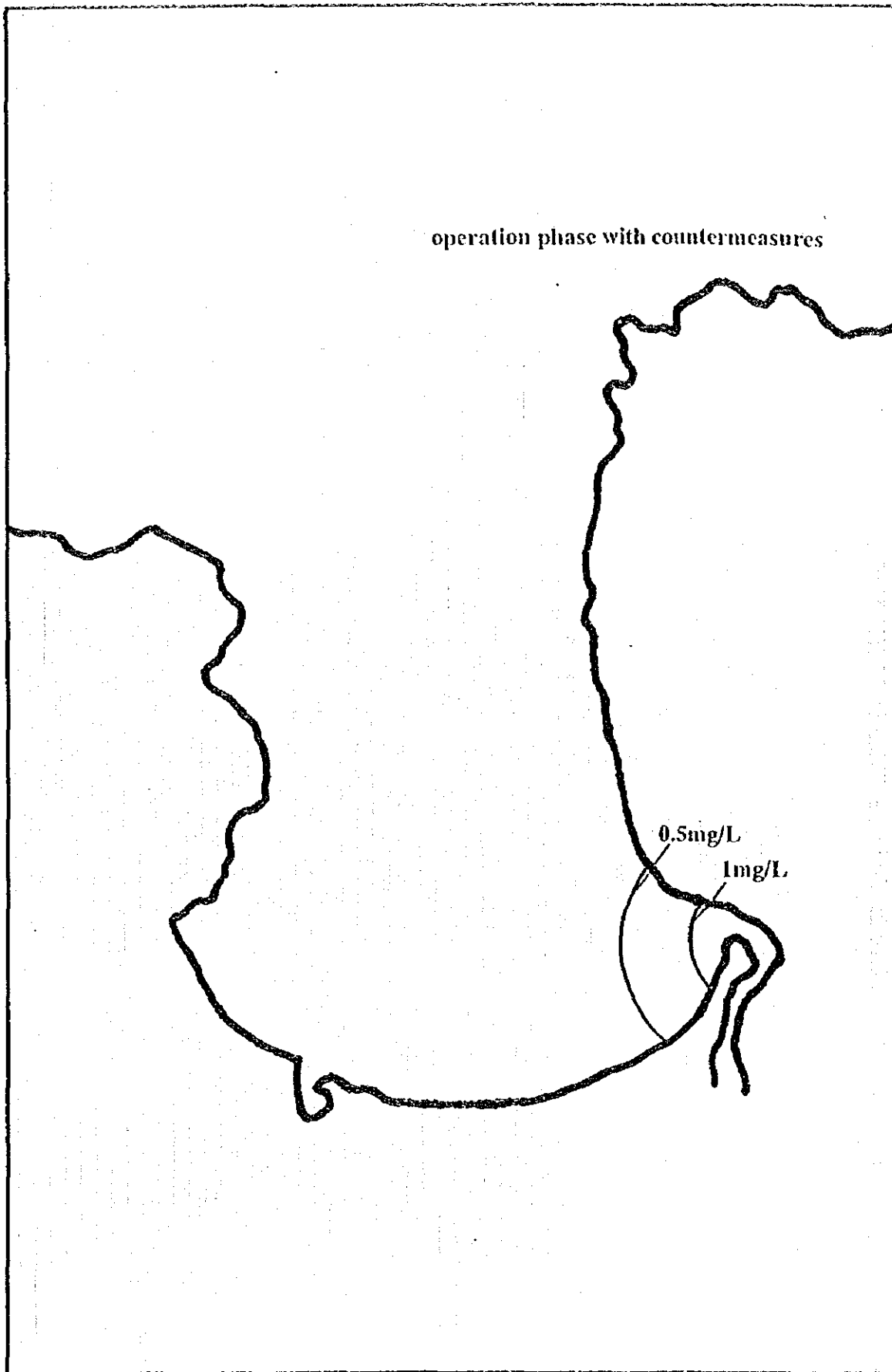
Source: Marine Survey, Study Team

Figure 6-8b Distribution of SS Concentration, Sub-block B. 3-2 Yokoton Bay, El Nido



Source: Marine Survey, Study Team

Figure 6-8c Distribution of SS Concentration, Sub-block E. 3-2 Yokoton Bay, El Nido



Source: Marine Survey, Study Team

6.3. Organic Water Pollution in Marine Coastal Area

1) Busuanga West

Organic pollutants generated from tourism facilities in the operation phase was estimated based on the proposed development plan. The Study Team proposes that tourism facilities should be equipped with settling ponds and waste recycling to the hinterland area should be done in order to get rid of the increase of the pollutant load. Therefore, if the proposed countermeasures are implemented no changes will occur in the future. Table 6-12 shows the present and future pattern of diffusion of COD concentration. For the future situation, the proposed countermeasures were not taken into account.

Calculation was done using Joseph-Sendner's equation.

$$S = (S_0 - S_1) [1 - \exp \{ Q (1/r - 1/r_1)/dp \}]$$

where, S: concentration at the distance (r) from the point of discharge (mg/l = ppm)
S₀: concentration level of discharged water at the outfall (mg/l)
S₁: concentration in the background (mg/l)
Q: discharge per unit time (m³/day)
d: mixing depth (m)
p: speed of diffusion (m/day); usually 1 0.5 cm/s (864 432 m/day)
r₁: distance from the point of discharge to the boundary of diffusion where no significant difference in concentration may be seen. This distance "r" can be obtained from the following Nitta's equation.

$$\log A = 1.226 \log Q + 0.0855$$

where, Q: discharge (m³/day)
A: diffusion area (m²), A = r²/2

If the proposed countermeasures are implemented, the COD distribution pattern will be very similar to that of the existing condition because of little change in the amount of pollution loads. Without countermeasures, the dispersion of COD will expand further in the future condition than in the existing condition. These results reveal that the proposed countermeasures play a significant role for marine environmental conservation.

Table 6-12 COD Load to the Marine Area During Operation phase, Busuanga West

Watershed No.	Watershed Sub-division No.	Facilities	Watershed Area (km ²)	Volume of Water Discharged from Facilities (m ³)	COD Concentration of Discharged Water (mg/L)	Load (kg/d)		
						Existing Condition	Additional Load due to Future Facilities	Future Condition
						A	B	C
9	9	Hotel 250 person	3.37	375	75	187.11	28.13	215.24
11	11-1	San Nicolas Sanitary District-2 Fisherman's Wharf	2.34	24	75	130.19	1.80	131.99
	11-2	San Nicolas Sanitary District-1 Marine Sports Complex, Aquarium, Fishery complex)	2.43	58	75	135.27	4.35	139.62
	11-10	San Rafael Sanitary District (7 Hotel Lots, Inland Sports Club, Amenity Core, Sea Side Flower Mall)	4.72	1,191	75	262.08	89.33	351.41

Source: Marine Survey, Study Team

- A Measured on the map
- B Estimated based on the proposed plan provisions of sewage treatment facilities will be required to same volume with the demand of future water supply.
- C Based on the past studies
- D $A/18 \times 1000$; Relationship between COD load and catchment area based on field data
- E $B \times C / 1000$
- F $D + E$

Table 6-13 COD Concentration and Distance from the Point of Discharge, Busuanga West

Watershed Subdivision	S (mg/L)	Distance: r (m)	
		Existing Condition	Future Condition
9	7.2	-	1
	6.4	1	5
	6.0	4	6
	5.0	7	9
	4.0	11	13
	4.0	16	20
	2.0	27	32
	1.0	55	64
11-1	6.6	-	1
	6.5	1	2
	6.0	3	3
	5.0	5	5
	4.0	8	8
	3.0	12	12
	2.0	19	19
	1.0	40	40
11-2	6.7	-	1
	6.5	1	2
	6.0	3	3
	5.0	5	6
	4.0	8	8
	3.0	12	13
	2.0	20	21
	1.0	41	42
11-10	8.4	-	1
	8.0	-	5
	7.0	-	9
	6.5	1	10
	6.0	6	12
	5.0	10	17
	4.0	15	23
	3.0	23	33
	2.0	38	52
1.0	77	101	

Source: Marine Survey, Study Team

Countermeasures are not taken into consideration for the future condition.

2) El Nido

The same analysis method for Busuanga West was used for El Nido. Full-scale countermeasures would contribute to the conservation of the marine environment so that the adverse effects due to the development could be mitigated. Otherwise the implementation of the plan will cause some negative impacts on the marine environment.

Table 6-14 COD load to the marine area in El Nido

Watershed No.	Watershed Subdivision No.	Facilities	Watershed Area (km ²)	Volume of Water Discharged from Facilities (m ³)	COD Concentration of Discharged Water (mg/L)	Load (kg/d)		
						Existing Condition	Additional Load due to Future Facilities	Future Condition
			A	B	C	D	E	F
1	1-2	Base Bay Sanitary District 7 Hotel Lots, Fisherman's Wharf, Inland Sports Club	7.81	510	75	433.70	38.25	471.95
3	3-2	Nacpan & Pasadena Sanitary District (4 Hotel Lots, Airport, Environment Center, Nido Center, Spa Resort, Orchid/Orchard Gardens, Butterfly/Insect Park, etc.)	82.59	395	75	4,588.25	29.63	4,617.88
7	7	Lamarao Sanitary District (7 Hotel Lots, Inland Sports Club, Shopping Mall)	26.32	686	75	1,461.94	51.45	1,513.39

Source: Marine Survey, Study Team

- A Measured on the map
- B Estimated based on the proposed plan provisions of sewage treatment facilities will be required to same volume with the demand of future water supply.
- C Based on the past studies
- D $A/18 \times 1000$; Relationship between COD load and catchment area based on field data
- E $B \times C / 1000$
- F $D + E$

Table 6-15 COD Concentration and the Distance From the Point of Discharge, El Nido

Watershed Subdivision	S (mg/L)	Distance: r (m)	
		Existing Condition	Future Condition
1-2	7.0	-	1
	6.4	1	10
	6.0	9	12
	5.0	16	19
	4.0	25	28
	3.0	38	42
	2.0	62	68
	1.0	124	134
	3-2	6.5	-
6.4		1	57
6.0		94	97
5.0		166	169
4.0		250	253
3.0		372	376
2.0		584	587
1.0		1,065	1,070
7	6.6	-	1
	6.4	1	25
	6.0	31	35
	5.0	54	58
	4.0	82	86
	3.0	123	129
	2.0	198	205
	1.0	383	392

Source: Marine Survey, Study Team

Countermeasures are not taken into consideration for future conditions.

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