

Appendix IX. Results of the causal chain analyses for Main Area of Concern 02: Habitat and Community Modification

Table A2.1: Environmental Impacts of Habitat and Community Modification (Severity)

Environmental Impacts	2.1.	2.2.1.	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.4	2.5	2.6	
	Shoreline change, due to modification, land	...upland / watershed habitats (>10 m elevation)	...coastal forest habitats	...coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10	...wetland habitats	...estuarine habitats	...mangrove habitats	Disturbance, damage and loss of coral reef habitats	...seagrass habitats	...macroalgal habitats	...soft sediment habitats	...deep water habitats (including sea mounts)	...pelagic habitats (nearshore <30 m, neritic 30-200m and	Increase in the occurrence of harmful or toxic algal blooms	Introduction of exotic non-native species, invasives and	SEVERITY
Loss of biodiversity	3	1	1	2	3	2	4	4	3	2	1	3	4	1	2	36
Increased risk of extinction of vulnerable / focal species	3			3	3	2	3	4	3			1	3	0	0	25
Loss of biomass 'carbon' sink			1	1	2		2	1	3	1	1	1	1			14
Increased GHG emissions (through burning)		1	1	1	1											4
Reduced area of critical habitats (feeding, breeding, spawning)	2	3	2	2	3	2	4	4	3	2	2	3	4	2	3	41
Changes to epifauna and infauna	1			1	1	1	1	1	1	1	1	1		1	1	12
Changes to trophic structure	1	1	1	1	2	2	3	4	3	2	2	2	4	3	2	33
Loss of 'natural' shoreline protection and increased risk of coastal flooding.	3	1	1	3	2	1	4	4	3	2	3				1	28
Increased coastal erosion	3	1	1	3	2	2	4	4	4	2	4					30
Changes to sediment composition (e.g. organic composition, particle size etc.)	3	3	2	3	3	3	3	4	3	2	3					32
Changes to sediment transport dynamics (accretion / siltation)	3	3	2	3	2	2	4	4	4	2	4					33
Reduced water clarity and light available to photosynthetic organisms (turbidity)	4	2	1	2	1	3	3	2	3	2	4			3		30
Reduced water quality (increased nutrients)	2	3	1		2		3	1	2	2	1	1		2		20
Reduced water quality (chemical contaminants)	1	1					1									3
Increased salt water intrusion (and salinisation of soils)	2	1			2	1	1									7
Loss of coastal vegetation	2		2	2	2		2									10
Modification of coastal hydrodynamics	3	2		2	1	1	3	3	3	1	2					21

Environmental Impacts	2.1.	2.2.1.	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.4	2.5	2.6	
	Shoreline change, due to modification, land ...upland / watershed habitats (>10 m elevation)	...coastal forest habitats	...coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10	...wetland habitats	...estuarine habitats	...mangrove habitats	Disturbance, damage and loss of coral reef habitats	...seagrass habitats	...macroalgal habitats	...soft sediment habitats	...deep water habitats (including sea mounts)	...pelagic habitats (nearshore <30 m, neritic 30-200m and	Increase in the occurrence of harmful or toxic algal blooms	Introduction of exotic non-native species, invasives and		SEVERITY
Creation of areas of 'hypoxic' areas (and smell)	1				1		1			2			3			8
Reduction in freshwater inflow into coastal waters	1	3	2	2	2	1										11
Changes in fisheries productivity	2	1	1	1	2	3	3	4	4	3	3	3	4	3	2	39
Changes in primary productivity	1	1	1	1	2	2	2	2	3	3	1	1	2	3	1	26
Changes in secondary productivity							2	2	2				2	3		11
Phase shifts and changes in community composition	3	1	1	2	1	2	3	4	3	2	2	3	3	3	3	36

Table 2: Inter-relationship between Habitat and Community Modification and other issues.

2.1.	2.2.1.	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.3.1.	2.3.2.	2.3.3.	2.3.4.	2.3.5.	2.4.	2.5.	2.6.	
Shoreline change, due to modification, land reclamation	... watershed and upland habitats	...coastal forest habitats	...coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	...wetland habitats	...estuarine habitats	...mangrove habitats	...coral reef habitats	...seagrass habitats	...macroalgal habitats	...soft sediment habitats	...deep water habitats (including coral, seagrass)	... of pelagic habitats (nearshore < 20 m, neritic > 20 m)	Increase in the occurrence of harmful or toxic algal blooms (HABs)	Introduction of exotic non-native species, invasives and	
	→														Alteration of natural river flow and changes in freshwater input and sediment load
→	→	→	→	→	→	→	→								Degradation of ground and surface water quality
	→	→		→	→	→						→			Microbiological contamination
	→	→		→	→	→	→	→	→	→		→	→		Nutrient enrichment
	→	→		→	→	→	→	→	→	→		→	→		Chemical contamination (excluding oil spills)
→	→	→	→	→	→	→	→	→	→	→		→	→		Suspended solids
	→	→		→	→	→						→			Solid wastes / marine debris (plastics etc.)
				→	→	→	→	→	→	→		→			Oil spills (drilling, exploitation, transport, processing, storage, shipping).
			→	→	→	→	→	→	→	→		→			Shoreline change, due to modification, land reclamation and coastal erosion
															...upland / watershed habitats (>10 m elevation)
	→		→									→	→		...coastal forest habitats
→	→	→		→	→	→	→	→	→	→		→	→		...coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)
→	→		→		→	→	→	→	→	→		→	→		...wetland habitats
→	→		→	→		→						→			...estuarine habitats
→	→	→	→	→	→		→	→	→	→		→			...mangrove habitats
→	→	→	→	→	→	→		→	→	→		→	→		...coral reef habitats
→	→	→	→	→	→	→	→		→	→		→			...seagrass habitats
→	→	→	→	→	→	→	→	→		→		→			...macroalgal habitats
→	→	→	→	→	→	→	→	→				→			...soft sediment habitats

2.1.	Shoreline change, due to modification, land reclamation
2.2.1.	... watershed and upland habitats
2.2.2.	...coastal forest habitats
2.2.3.	...coastal habitats (beaches, dunes, coastal vegetation and ...)
2.2.4.	...wetland habitats
2.2.5.	...estuarine habitats
2.2.6.	...mangrove habitats
2.3.1.	...coral reef habitats
2.3.2.	...seagrass habitats
2.3.3.	...macroalgal habitats
2.3.4.	...soft sediment habitats
2.3.5.	...deep water habitats (including sea mounts)
2.4.	... of pelagic habitats (nearshore < 20 m, neritic 20-200 m)
2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)
2.6.	Introduction of exotic non-native species, invasives and
	...deep water habitats (including sea mounts)
→	Disturbance, damage and degradation of pelagic habitats
→	Increase in the occurrence of harmful or toxic algal blooms (HABs)
	Introduction of exotic non-native species, invasives and nuisance species
	Declines in populations of marine mammals
	Declines in populations of cetaceans
→	Declines in populations shore and seabirds
→	Declines in populations of turtles
	Declines in populations of sharks and rays
	Declines in populations of large pelagics
	Declines in populations of small pelagics
	Declines in populations of deep water demersals
	Declines in populations of reef and demersal fish
	Declines in populations of molluscs (bivalves, gastropods)
	Declines in populations of cephalopods
	Declines in populations of sea cucumbers
	Declines in populations of prawns and shrimp
	Declines in populations of lobsters
	Declines in populations of crabs
	Excessive bycatch and discards
	Expansion of mariculture industry (biosecurity, diseases in wildstocks, etc.)

Table A2.3 Ecosystem Services affected by Environmental Impacts of Habitat and Community Modification

Environmental Impacts	PROVISIONING SERVICES								REGULATING									SUPPORTING				CULTURAL & AMENITY							
	Pro01	Pro02	Pro03	Pro04	Pro05	Pro06	Pro07	Pro08	Reg01	Reg02	Reg03	Reg04	Reg05	Reg06	Reg07	Reg08	Reg09	Sup02	Sup02	Sup03	Sup04	Cul01	Cul02	Cul03	Cul04	Cul05	Cul06	Cul07	Cul08
	Food (e.g. fish, game fruit)	Freshwater (e.g. for drinking, irrigation)	Raw materials (e.g. fibre, timber)	Genetic resources (e.g. for crop)	Biochemical medicines and products	Ornamental resources (e.g. plants)	Geological resources*	Energy*	Air quality regulation (e.g. particulate matter)	Climate regulation (e.g. Carbon sequestration)	Natural hazard regulation (e.g. erosion control)	Regulation of water flows (e.g. flood control)	Waste treatment (especially nutrients)	Erosion regulation / prevention	Nutrient cycling and soil fertility	Pollination	Biological control (e.g. Seed dispersal)	Maintenance of life cycles (incl. genetic diversity)	Maintenance of genetic diversity	Photosynthesis and primary productivity	Secondary production*	Aesthetics information	Opportunities for recreation	Inspiration for culture, art and science	Spiritual experience	Bequest, intrinsic and existence*	Information for cognitive development	Social relations*	Sense of place*
Loss of biodiversity	↑		↑	↑	↑	↑											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Increased risk of extinction of vulnerable / focal species	↑			↑	↑												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Loss of biomass 'carbon' sink										↑	↑															↑	↑		
Increased GHG emissions (through burning)								↑	↑	↑																↑	↑		
Reduced area of critical habitats (feeding, breeding, spawning)	↑			↑		↑									↑	↑	↑	↑	↑	↑	↑		↑			↑			↑
Changes to epifauna and infauna	↑			↑											↑	↑	↑	↑	↑	↑	↑					↑			
Changes to trophic structure	↑														↑	↑	↑	↑	↑	↑	↑					↑	↑		
Loss of 'natural' shoreline protection and increased risk of coastal flooding.		↑									↑	↑		↑				↑	↑	↑	↑	↑	↑			↑		↑	↑
Increased coastal erosion		↑									↑	↑		↑				↑	↑	↑	↑	↑	↑			↑		↑	↑
Changes to sediment composition (e.g. organic composition, particle size etc.)							↑				↑	↑		↑	↑			↑	↑	↑	↑	↑	↑			↑			
Changes to sediment transport dynamics (accretion / siltation)							↑				↑	↑		↑	↑			↑	↑	↑	↑	↑	↑			↑			
Reduced water clarity and light available to photosynthetic organisms (turbidity)	↑														↑		↑	↑	↑	↑	↑	↑	↑			↑			↑
Reduced water quality (increased nutrients)	↑												↑		↑		↑	↑	↑	↑	↑	↑	↑			↑			↑
Reduced water quality (chemical contaminants)	↑												↑		↑		↑	↑	↑	↑	↑	↑	↑			↑			↑
Increased salt water intrusion (and salinisation of soils)	↑	↑											↑		↑		↑		↑			↑	↑			↑			
Loss of coastal vegetation	↑							↑	↑	↑	↑	↑	↑	↑	↑			↑		↑		↑	↑	↑		↑			↑
Modification of coastal hydrodynamics	↑																	↑		↑		↑	↑			↑			↑
Creation of areas of 'hypoxic' areas (and smell)	↑							↑	↑				↑		↑		↑	↑	↑	↑	↑	↑	↑			↑			↑
Reduction in freshwater inflow into coastal waters	↑											↑	↑		↑		↑	↑	↑	↑	↑					↑			
Changes in fisheries productivity	↑			↑	↑	↑									↑			↑	↑	↑	↑		↑	↑		↑		↑	↑
Changes in primary productivity	↑			↑	↑	↑									↑			↑	↑	↑	↑		↑			↑			
Changes in secondary productivity	↑			↑	↑	↑									↑			↑	↑	↑	↑		↑			↑			
Phase shifts and changes in community composition	↑			↑	↑	↑					↑				↑			↑	↑	↑	↑	↑	↑			↑			

Table A2.4 Socio-economic impacts as a result of a loss of Ecosystem Services due to Habitat Community Modification

	PROVISIONING SERVICES								REGULATING SERVICES									SUPPORTING				
	Pro01	Pro02	Pro03	Pro04	Pro05	Pro06	Pro07	Pro08	Reg01	Reg02	Reg03	Reg04	Reg05	Reg06	Reg07	Reg08	Reg09	Sup01	Sup02	Sup03	Sup04	Cui01
Socio-economic Impacts	Food (e.g. fish, game fruit)	Freshwater (e.g. for drinking, irrigation, cooling)	Raw materials (e.g. fibre, timber, fuel, wood, fodder)	Genetic resources (e.g. for crop improvements and medicinal)	Biochemical medicines and pharmaceuticals (e.g.)	Ornamental resources (e.g. artichoke, wick, decorative plants)	Geological resources*	Energy*	Air quality regulation (e.g. Carbon, dust, chemicals, etc.)	Climate regulation (e.g. Carbon sequestration, influence of)	Natural hazard regulation (e.g. Storm protection and flood)	Regulation of water flows (e.g. Natural drainage, irrigation and)	Waste treatment (especially water purification)	Erosion regulation / prevention	Nutrient cycling and maintenance of fertility/Incl.	Pollination	Biological control (e.g. Seed disease, pest and disease)	Maintenance of life cycles (incl. nurseries, spawning, breeding)	Maintenance of genetic diversity (e.g. gene pool protection)	Photosynthesis and primary production*	Secondary production*	Aesthetics information
Increased risk of coastal flooding										↑	↑	↑		↑								
Increased risk to human life									↑	↑	↑	↑										
Loss of property										↑	↑	↑										
Reduction in property / real estate value									↑	↑	↑	↑	↑	↑								
Loss of infrastructure										↑	↑	↑	↑	↑								
Increased costs of sea defence										↑	↑	↑		↑								
Change in livelihood	↓									↑	↑	↑	↑	↑	↑		↑					
Increased operational costs (increased travel costs due to loss of landing sites for fishers)	↓													↑								
Reduction in recreational space available for local community (e.g. beach barbeques)														↑								↓
Reduction in recreational space available for tourists														↑								↓
Loss of foreign revenues			↓								↓	↓	↓	↓	↓			↓	↓	↓	↓	↓
Reduction in GDP	↓		↓						↓	↓	↓	↓	↓	↓	↓			↓	↓	↓	↓	↓
Reduction in income generating livelihoods (non-fisheries related e.g. tourism)	↓		↓			↓				↓	↓	↓	↓	↓	↓		↓	↓	↓	↓	↓	↓
Reduction in income generating livelihoods (fisheries related)	↓									↓			↓	↓	↓		↓	↓	↓	↓	↓	↓
Reduced resilience / increased vulnerability	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Reduced food availability / security	↓											↓	↓		↓	↓	↓	↓	↓	↓	↓	↓
Reduced availability of favoured food fishes / loss of traditions	↓											↓					↓					↓
Increased malnutrition	↓									↓	↓	↓	↓	↓	↓		↓	↓	↓	↓	↓	↓
Increased cost of living	↓	↓	↓				↓			↓	↓	↓	↓	↓	↓		↓	↓	↓	↓	↓	↓
Reduced attractiveness of coastal areas due to unpleasant odour (stagnant water)			↓									↓	↓		↓					↓	↓	↓
Loss of landscape and seascape aesthetics			↓						↓			↓	↓	↓	↓			↓			↓	↓
Loss of cultural heritage and traditions	↓													↓				↓				↓
Loss of inspiration and materials for local artworks						↓				↓	↓	↓	↓	↓	↓			↓				↓

	PROVISIONING SERVICES								REGULATING SERVICES									SUPPORTING				Cul01
	Pro01	Pro02	Pro03	Pro04	Pro05	Pro06	Pro07	Pro08	Reg01	Reg02	Reg03	Reg04	Reg05	Reg06	Reg07	Reg08	Reg09	Sup01	Sup02	Sup03	Sup04	
Socio-economic Impacts	Food (e.g. fish, game fruit)	Freshwater (e.g. for drinking, irrigation, cooking)	Raw materials (e.g. fibre, timber, fuel, wood, fodder)	Genetic resources (e.g. for crop improvements and medicinal)	Biochemical medicines and pharmaceuticals (e.g.)	Ornamental resources (e.g. artistic work, decorative plants)	Geological resources*	Energy*	Air quality regulation (e.g. Capturing dust, chemicals, etc)	Climate regulation (e.g. Carbon sequestration, influence of)	Natural hazard regulation (e.g. Storm protection and flood)	Regulation of water flows (e.g. Natural drainage, irrigation and water purification)	Waste treatment (especially water purification)	Erosion regulation / prevention	Nutrient cycling and maintenance of fertility/land	Pollination	Biological control (e.g. Seed dispersal, pest and disease)	Maintenance of life cycles (incl. nursery, coarising, breeding)	Maintenance of genetic diversity (e.g. seed bank, protection)	Photosynthesis and primary production*	Secondary production*	Aesthetics information
Reduction in availability of traditional handicrafts						↑								↑	↑			↑				
Reduced availability of traditional medicines			↑		↑							↑							↑			
Loss of habitats important for religious festivals and rituals														↑				↑				
Reduction in air quality (increase in respiratory diseases)			↑						↑													
Reduced well-being	↑	↑	↑			↑			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Increased stress	↑	↑	↑			↑			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Loss of social cohesion	↑	↑	↑			↑			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Increase in social conflicts	↑	↑	↑			↑			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Increase in unemployment	↑	↑	↑			↑			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑		↑		↑
Increase in climate variability and change																						
Reduced revenue from fisheries	↑									↑	↑							↑		↑	↑	
Reduced freshwater availability		↑																				
Reduced availability of raw materials (building etc)			↑															↑				
Threats to public health									↑	↑	↑	↑	↑	↑	↑		↑					
Reduction in bathing water quality										↑		↑	↑		↑							
Reduction in quality of seafood	↑											↑	↑		↑		↑					
Increased poverty and inequality	↑								↑	↑	↑	↑	↑	↑	↑		↑	↑	↑	↑	↑	

Table A2.5: Socio-Economic Impacts of Habitat and Community Modification - SEVERITY

Socio-economic Impacts	2.1.	2.2.1	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.3.1.	2.3.2.	2.3.3.	2.3.4.	2.3.5.	2.4.	2.5.	2.6.	
	Shoreline change, due to modification, land reclamation	... watershed and upland habitats	...coastal forest habitats	...coastal habitats (beaches, dunes, coastal vegetation and	...wetland habitats	...estuarine habitats	...mangrove habitats	...coral reef habitats	...seagrass habitats	...macroalgal habitats	...soft sediment habitats	...deep water habitats (including sea mounts)	... of pelagic habitats (nearshore <30 m, neritic 30-	Increase in the occurrence of harmful or toxic algal blooms	Introduction of exotic non-native species, invasives and	SEVERITY
Increased risk of coastal flooding	4		2	4	1	1	4	4								20
Increased risk to human life	4		1	4	1	1	4	4								19
Loss of property	4	1	1	4	1		4	4								19
Reduction in property / real estate value	4	1	1	4	1		1	4								16
Loss of infrastructure	4	1	1	4	1	1	2	4								18
Increased costs of sea defence	4	1	1	4	1	1	4	4								20
Change in livelihood	4		4	4			4	4	3		2		4	2		31
Increased operational costs (e.g. due to increased travel costs due to loss of landing sites for fishers, fishing grounds etc)	4			4			4	4	3		2		4	2		27
Reduction in recreational space available for local community (e.g. beach barbeques)	3		1	3				2					2	2		13
Reduction in recreational space available for tourists	3		1	3			4	4					3	2		20
Loss of foreign revenues	4			4			3	4					4	4		23
Reduction in GDP	4			4			3	4			2		4	4	4	29
Reduction in income generating livelihoods (non-fisheries related e.g. tourism)	4		2	4			3	4					4	3	2	26
Reduction in income generating livelihoods (fisheries related)	4	3		4			4	4	4	4	4	4	4	3	4	46
Reduced resilience / increased vulnerability	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	59
Reduced food availability / security					3	3	4	4	4	3	3	3	4	4	4	39
Reduced food availability / security due to degradation of soil quality (salinisation).	2	2	2	2			4	4	4							20
Reduced food availability / security due to the loss of coastal habitat			4	4												8
Reduced availability of favoured food fishes / loss of traditions								4								4
Increased malnutrition	2			2			3	4	4		4		4			23
Increased cost of living			2				2	2					4		2	12
Reduced attractiveness of coastal areas due to unpleasant odour (stagnant water)	4													4		8
Loss of landscape and seascape aesthetics	4	4	4	4			4	4	4				4	2	4	38

Socio-economic Impacts	2.1.	2.2.1	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.3.1.	2.3.2.	2.3.3.	2.3.4.	2.3.5.	2.4.	2.5.	2.6.	
	Shoreline change, due to modification, land reclamation	... watershed and upland habitats	... coastal forest habitats	... coastal habitats (beaches, dunes, coastal vegetation and	... wetland habitats	... estuarine habitats	... mangrove habitats	... coral reef habitats	... seagrass habitats	... macroalgal habitats	... soft sediment habitats	... deep water habitats (including sea mounts)	... of pelagic habitats (nearshore <30 m, neritic 30-	Increase in the occurrence of harmful or toxic algal blooms	Introduction of exotic non-native species, invasives and	SEVERITY
Loss of cultural heritage and traditions	4	4	4	4				4	4				2		4	30
Loss of inspiration and materials for local artworks		4	4	4			4									16
Reduction in availability of traditional handicrafts		4	4													8
Reduced availability of traditional medicines		4	4													8
Loss of habitats important for religious festivals and rituals	3	4	4	3												14
Reduction in air quality (increase in respiratory diseases)		4	4													8
Reduced well-being	4	4	4	4			4	4					4			28
Increased stress	4	4	4	4	4		4	4								28
Loss of social cohesion	4	4	4	4			4	4								24
Increase in social conflicts	4	4	4	4			4	4	4		2		4			34
Increased unemployment	2	4	4	4			4	4	4		2		4		2	34
Increased vulnerability to climate variability and change	4	4	4	4	4	4	4	4	4							36
Reduced revenue from fisheries							4	4	4		2		4	4	2	24
Reduced freshwater availability		4	3												2	9
Reduced availability of raw materials (building etc)			4	4			4	4								16
Threats to public health		4		4	4	4							4	4	4	28
Reduction in bathing water quality													4	4	4	12
Reduction in quality of seafood						4	4	4					4	4	4	24
Increased poverty and inequality	3		4	4	3	3	4	4			4		4	4	4	41

Table A2.7A: Direct Causes of Habitat and Community Modification - Contribution

Direct Causes	2.1	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.4	2.5	2.6	Contribution
	Shoreline change, due to modification, land reclamation and coastal	...upland / watershed habitats (>10 m elevation)	...coastal forest habitats	...coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to	...wetland habitats	...estuarine habitats	...mangrove habitats	...coral reef habitats	...seagrass habitats	...macroalgal habitats	...soft sediment habitats	...deep water habitats (including sea mounts)	pelagic habitats	... harmful or toxic algal blooms (HABs)	Introduction of exotic non-native species, invasives and nuisance species	
Physical removal of sediments	3		1	3					1		4					12
Construction of hard shoreline defence structures	2			2												4
Beach replenishment / creation	1			1					1		1					4
Infilling and land reclamation	1			1	4		3	2	2	1						14
Changes in land use and vegetation cover (e.g. grazing)	2	3	2	3	4											14
Changes in the natural sediment transport patterns	2			2		2	1	2	2		1					12
Physical habitat disturbance, removal and loss	2	3	2	4	4	2	4	2	4	1	2	1				31
Overextraction of non-living marine resources	1			2				1	3		2		1			10
Destructive fishing practices							3	3	2		2	2	2			14
Overexploitation of living marine resources								1	1			1				3
Oil spills and pollution (marine)				1	1	1	1	1	1		1		1			8
Chemical pollution					1	1	1	1	1		1		1			7
Nutrient pollution					1	1	1	1	1	1	1		1	4		12
Microbial pollution					1	1	1	1	1	1	1		1			8
Noise pollution													1			1
Suspended solids (turbidity)					1			3	2	1	1		1			9
Anchoring								2	1				1			4
Siltation / sedimentation	3			3	1	1	1	3	2	1	1					16
Coastal erosion	4			3			1				1					9

	2.1	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.4	2.5	2.6	
Direct Causes	Shoreline change, due to modification, land reclamation and coastal	...upland / watershed habitats (>10 m elevation)	...coastal forest habitats	...coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to	...wetland habitats	...estuarine habitats	...mangrove habitats	...coral reef habitats	...seagrass habitats	...macroalgal habitats	...soft sediment habitats	...deep water habitats (including sea mounts)	pelagic habitats	... harmful or toxic algal blooms (HABs)	Introduction of exotic non-native species, invasives and nuisance species	Contribution
Coral reef degradation	4			2			1		1					3		11
Natural climate variability and change	3	2	2	2	2	2	2	4	1	1				2	2	25
Increased sea water temperature					1			4	1	1			2	2		11
Ocean acidification								2								2
Cyclones	3	2	1	3	2	1	1	2	1	1	1					18
Increased frequency and intensity of storm waves (e.g. cyclones, tsunami etc.)	3			3	2	1	2	1	1	1	1					15
Cold water upwelling												1				1
Sea level rise	3		1	2	2	2	1									11
Disease and plague organisms							1	2								3
Direct introduction								1							3	4
Accidental introductions								1					1	4	4	10
Light				1									1			2
TOTAL	37	10	9	38	27	15	25	40	30	10	21	5	14	15	9	

Table A2.7B: Direct Causes of Habitat and Community Modification - Irreversibility

	2.1.	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.4.	2.5.	2.6.	
Direct Causes	Shoreline change, due to modification, land reclamation and erosion	...upland / watershed habitats (>10 m elevation)	...coastal forest habitats	...coastal habitats (beaches, dunes, etc...10 m elevation)	...wetland habitats	...estuarine habitats	...mangrove habitats	...coral reef habitats	...seagrass habitats	...macroalgal habitats	...soft sediment habitats	...deep water habitats (including sea mounts)	pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	... harmful or toxic algal blooms (HABs)	... exotic non-native species, invasives and nuisance species	Irreversibility
Physical removal of sediments	4		4	4					4		4					20
Construction of hard shoreline defence structures	3			3												6
Beach replenishment / creation	2			2					2		2					8
Infilling and land reclamation	4			4	4		4	4	4	4						28
Changes in land use and vegetation cover (e.g. grazing)	3	1	1	1	1			1								8
Changes in the natural sediment transport patterns	4			2		2	2	2			4					16
Physical habitat disturbance, removal and loss	3	2	2	2	2	2	2	4	3		3					25
Overextraction of non-living marine resources	3			4				3	3		3		2			18
Destructive fishing practices							2	3	2	2	2	3	2			16
Overexploitation of living marine resources							2	2	2	2	2		2			12
Oil spills and pollution (marine)				1	2	2	4	2	2		3		1			17
Chemical pollution					2	2	2	2	2		2		2			14
Nutrient pollution					2	2	2	2	2		2		2			14
Microbial pollution					2	2	2	2	2		2		2			14
Noise pollution													2			2
Suspended solids (turbidity)					2		2	2	2		2		2			12
Anchoring								2	2							4
Siltation / sedimentation	2			2	2	2	2	2	2	2	2					18

	2.1.	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.4.	2.5.	2.6.	
Direct Causes	Shoreline change, due to modification, land reclamation and erosion	...upland / watershed habitats (>10 m elevation)	...coastal forest habitats	...coastal habitats (beaches, dunes, etc..10 m elevation)	...wetland habitats	...estuarine habitats	...mangrove habitats	...coral reef habitats	...seagrass habitats	...macroalgal habitats	...soft sediment habitats	...deep water habitats (including sea mounts)	pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	... harmful or toxic algal blooms (HABs)	... exotic non-native species, invasives and nuisance species	Irreversibility
Coastal erosion	4			4			2	2			2					14
Coral reef degradation	4			4			4		4	4						20
Natural climate variability and change	4	4	4	4	4	4	4	4	4				4		4	44
Increased sea water temperature					3			3								6
Ocean acidification					?			3								3
Cyclones	3	2	2	2	2	2	2	2	2	2	2					23
Increased frequency and intensity of storm waves (e.g. cyclones, tsunami etc.)	3			2	2	2	2	2								13
Cold water upwelling																0
Sea level rise	4		4	4	4	4	4	4								28
Disease and plague organisms							3	3							4	10
Direct introduction								4					4	4	4	16
Accidental introductions													4	4	4	12
Light				2												2
TOTAL	50	9	17	47	34	26	47	60	44	16	37	3	29	8	16	

Table A2.8 : Direct Causes and Sectors contributing towards Habitats and Community Modification

Direct Causes	Urbanisation	Tourism	Agriculture & Forestry	Industry	Transportation & Shipping	Mining	Fisheries (industrial / commercial)	Fisheries (semi-industrial - local)	Fisheries (artisanal / traditional)	Fisheries (small scale)	Fisheries (inshore trawl fishery)	Fisheries (recreational)	Fisheries (sports)	Fisheries (poaching)	Fisheries (mariculture)	Energy	Natural environmental variability	TOTAL (no sectors)
Physical removal of sediments	✓	✓		✓	✓	✓												5
Construction of hard shoreline defence structures	✓	✓																2
Beach replenishment / creation		✓																1
Infilling and land reclamation	✓	✓		✓	✓	✓										✓		6
Changes in land use and vegetation cover (e.g. grazing)	✓	✓	✓	✓	✓	✓											✓	7
Changes in the natural sediment transport patterns	✓	✓	✓	✓	✓	✓											✓	7
Physical habitat disturbance, removal and loss	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓				12
Overextraction of non-living marine resources	✓	✓		✓		✓												4
Destructive fishing practices							✓	✓	✓	✓	✓	✓		✓				7
Overexploitation of living marine resources	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓			11
Oil spills and pollution (marine)	✓	✓		✓	✓		✓	✓	✓							✓		8
Chemical pollution	✓	✓	✓	✓	✓	✓									✓	✓		8
Nutrient pollution	✓	✓	✓	✓	✓										✓			6
Microbial pollution	✓	✓	✓												✓			4
Noise pollution					✓	✓	✓				✓							4
Suspended solids (turbidity)	✓	✓	✓	✓	✓	✓					✓				✓			8
Anchoring		✓			✓		✓	✓	✓	✓	✓	✓	✓	✓				10

	Urbanisation	Tourism	Agriculture & Forestry	Industry	Transportation & Shipping	Mining	Fisheries (industrial / commercial)	Fisheries (semi-industrial - local)	Fisheries (artisanal / traditional)	Fisheries (small scale)	Fisheries (inshore trawl fishery)	Fisheries (recreational)	Fisheries (sports)	Fisheries (poaching)	Fisheries (mariculture)	Energy	Natural environmental variability	TOTAL (no sectors)
Direct Causes																		
Siltation / sedimentation	✓	✓	✓	✓	✓	✓					✓							7
Coastal erosion						✓											✓	2
Coral reef degradation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	17
Natural climate variability and change																✓	✓	2
Increased sea water temperature																✓	✓	2
Ocean acidification																✓	✓	2
Cyclones																	✓	1
Increased frequency and intensity of storm waves (e.g. cyclones, tsunami etc.)																	✓	1
Cold water upwelling																	✓	1
Sea level rise																	✓	1
Disease and plague organisms	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓	13
Direct introduction															✓			1
Accidental introductions					✓		✓								✓			3
Light	✓	✓			✓													3
TOTAL (no. causes)	16	18	10	12	16	12	9	7	7	6	9	4	3	5	9	7	12	

Table A2.9: Sectors, Resource Use Practices, Underlying and Root Causes

Sector and Underlying Resource Use Practice	Underlying Social, Economic, Legal and Political Causes	Root Causes									
		[A] Inappropriate governance	[B] Economic drivers	[C] Inadequate financial resources	[D] Inadequate knowledge and awareness	[E] Cultural traditions	[F] Population pressure	[G] Poverty and inequality	[H] Climate change and natural processes	[I] Voluntary action fills the governance void	[J] Personal Attitude
2.1	Shoreline change										
Tourism											
(1) Infill sea frontage to increase land for recreation	Increasing demand for land for tourist development	↑	↑		↑						
(3) Coastal development activities	Non-compliance with coastal set back	↑	↑				↑				
	Weak enforcement of coastal set-back	↑	↑	↑							
	Environment inspectors lack resources (e.g. fuel)	↑		↑							
	Environment inspectors lack knowledge (of marine and coastal issues)	↑		↑	↑						
	Developers and hoteliers fail to comply with coastal set-back	↑	↑							↑	
(3) Use of groins in front of hotels to retain beach frontage	Weak enforcement of coastal set-back	↑	↑	↑							
	Lack of extension officers / environment inspectors	↑		↑							
	Environment inspectors lack resources (e.g. fuel)	↑		↑							
	Environment inspectors lack knowledge (of marine and coastal issues)	↑		↑	↑						
	Gap in legislation relating to construction of groins	↑									
	Legal issues related to land ownership	↑					↑				
Transportation and Shipping											
(4) Dredging in port entrance and to maintain shipping channels	Weaknesses in EIA process related to dredging	↑	↑	↑							
	Lack of training in EIA	↑			↑						
(5) Dredge spoils used to reclaim land	Demand for flat land		↑				↑	↑			
	Lack of training in EIA	↑		↑	↑						
	Lack of ICZM plan / ICZM plan not implemented	↑		↑	↑						
	Limited financial resources for implementation of ICZM			↑							
Urbanisation											
(6) Sand mining from coastal rivers and beaches for construction	High local demand for sand for construction industry		↑				↑				
	Sand mining - low skilled and low technology livelihood		↑		↑			↑			
	Lack of alternative livelihood for miners						↑	↑			
	Non-compliance with regulations concerning sand mining	↑			↑					↑	
	Weak enforcement of sand mining in designated sites	↑		↑	↑						
	Lack of knowledge and awareness in				↑						

Sector and Underlying Resource Use Practice	Underlying Social, Economic, Legal and Political Causes	Root Causes									
		[A] Inappropriate governance	[B] Economic drivers	[C] Inadequate financial resources	[D] Inadequate knowledge and awareness	[E] Cultural traditions	[F] Population pressure	[G] Poverty and inequality	[H] Climate change and natural processes	[I] Voluntary action fills the governance void	[J] Personal Attitude
Waves									↑		
Heavy rains									↑		
Increased storm frequency									↑		
Storm surges									↑		
2.2.1	Upland / watershed habitats										
Agriculture & Forestry											
(1) Logging by companies (joint foreign and national venture)	International demand for timber	↑	↑		↑						
	Overexploitation of resource		↑		↑						
	No replanting			↑	↑						
	No enforcement of legislation	↑		↑							
	Other economic priorities	↑	↑	↑	↑						
	Corruption	↑	↑							↑	
	Lack of technical capacity (human and technology)	↑		↑	↑						
2.2.3	Coastal habitats (e.g. Beaches, dunes)										
Tourism											
(1) Damage to habitats and sensitive areas	Lack of compliance with building regulations	↑	↑							↑	
	Unemployment and migration to coast	↑	↑						↑	↑	
	Lack of ICZM plan / ICZM plan not implemented	↑	↑	↑					↑	↑	
(2) Construction too close to the shoreline	Complicated planning with many mandated authorities	↑		↑							
	Poor communication between mandated planning authorities	↑		↑							
	Failure to enforce legislation	↑		↑							
	Lack of ICZM plan / ICZM plan not implemented	↑	↑								
	Limited financial resources for implementation of ICZM			↑							
	Lack of technical capacity			↑	↑						
	Lack of transparency in planning process	↑		↑							
	Corruption	↑		↑						↑	
(3) Damage to sensitive habitats (e.g. walking on sand dunes)	Rapid unplanned expansion of tourism sector	↑	↑								
	No marked trails and lack awareness of the need	↑		↑							
	Lack of ICZM plan / ICZM plan not implemented	↑	↑								
	Lack of technical capacity	↑		↑							
	Limited financial resources for implementation of ICZM			↑							
Urbanisation											
(4) Abstraction of freshwater	Increasing demand for freshwater	↑			↑	↑					

Sector and Underlying Resource Use Practice	Underlying Social, Economic, Legal and Political Causes	Root Causes									
		[A] Inappropriate governance	[B] Economic drivers	[C] Inadequate financial resources	[D] Inadequate knowledge and awareness	[E] Cultural traditions	[F] Population pressure	[G] Poverty and inequality	[H] Climate change and natural processes	[I] Voluntary action fills the governance void	[J] Personal Attitude
(5) Desalination plants	Increasing population Demand for fresh water Lack of compliance with regulation	↑					↑	↑		↑	
											↑
(6) Levelling of coastal land for development	Increasing population Migration and expansion of coastal communities Demand for flat land for development Complicated planning with many mandated authorities Lack of planning and no ICZM	↑	↑				↑	↑	↑		
			↑				↑	↑	↑		
						↑					
(7) Construction of villages too close shoreline (e.g. on dunes)	Migration and expansion of coastal communities Complicated planning with many mandated authorities Poor communication between mandated planning authorities Lack of ICZM plan / ICZM plan not implemented Failure to enforce legislation Corruption		↑					↑	↑		
Energy	Lack of compliance with regulation	↑		↑				↑			
(8) Power station development on coast											
Mining	Market demand for geological resources Market demand for building resources Poor enforcement of EIA regulations	↑	↑	↑			↑	↑			
Natural environmental variability and change	Sea level rise Extreme storms Climatic variability Dynamic coastlines High energy coasts Carbon emissions Drought						↑				↑
						↑					↑
					↑						↑
											↑
											↑
											↑
											↑
											↑
											↑
											↑
											↑
2.2.6 Mangroves											
Agriculture & Forestry											
(1) Overcutting for fuelwood and timber	Increased demand for wood products No alternative fuel source Quality of the product (rot-proof) Inland forest degradation Inadequate regulation, enforcement and		↑					↑	↑		
			↑					↑	↑		
			↑					↑	↑		
			↑					↑	↑		

Sector and Underlying Resource Use Practice	Underlying Social, Economic, Legal and Political Causes	Root Causes									
		[A] Inappropriate governance	[B] Economic drivers	[C] Inadequate financial resources	[D] Inadequate knowledge and awareness	[E] Cultural traditions	[F] Population pressure	[G] Poverty and inequality	[H] Climate change and natural processes	[I] Voluntary action fills the governance void	[J] Personal Attitude
	No alternatives			↑			↑	↑			
Urbanisation											
(11) Clearing of mangroves for road construction	Poor land use planning	↑	↑				↑	↑			
(12) Inappropriate disposal of solid waste litter	Increased coastal population Inadequate provision for solid waste disposal	↑		↑	↑	↑	↑				
(13) Inappropriate disposal of un- treated domestic wastewater	Increased coastal population Inadequate wastewater infrastructure	↑		↑	↑		↑	↑			
(14) Clearing of mangrove to improve the 'view'	Lack of compliance with regulations Lack of enforcement Lack of awareness	↑			↑		↑	↑			
Industry											
(15) Disposal of un- treated industrial wastewater	Lack of treatment facilities for industrial effluents Lack of compliance with regulations	↑	↑	↑	↑						
(16) Disposal of solid waste litter	Inadequate waste collection Lack of compliance with regulations	↑		↑							
(17) Clearing for salt pans	Lack of compliance with regulations		↑								
Tourism											
(18) Physical damage	Coastal development for tourism industry	↑	↑		↑	↑					
(19) Clearing of mangroves to improve the 'view'	Lack of compliance with regulations Knowledge awareness and use of best practice	↑			↑		↑				
Natural environmental variability and change											
Increasing frequency of storms									↑		
Storm surges									↑		
Waves									↑		
2.3.1. Coral reef habitats											
Tourism											
(1) Trampling	Market demand for tourism activities Ignorance / Lack of awareness		↑								↑
(2) Collection ornamental products (by tourists)	Lack of enforcement outside MPAs Lack of capacity in Min. of Tourism	↑		↑	↑						
(2) Harvesting of shells and ornamental products (by locals) for sale to tourists	Market demand from tourist trade Money making livelihood		↑						↑	↑	
(3) Anchor damage by (i) charter boats	Lack of enforcement of the law Market demand for charters and bare boat charters (no skipper)	↑		↑	↑				↑		↑

Sector and Underlying Resource Use Practice	Underlying Social, Economic, Legal and Political Causes	Root Causes										
		[A] Inappropriate governance	[B] Economic drivers	[C] Inadequate financial resources	[D] Inadequate knowledge and awareness	[E] Cultural traditions	[F] Population pressure	[G] Poverty and inequality	[H] Climate change and natural processes	[I] Voluntary action fills the governance void	[J] Personal Attitude	
(8) Accidental release of contaminants from ships and ports	guidelines											
	Lack of capacity to monitor and enforce guidelines	↑		↑								
	Other priorities		↑									
	Limited waste disposal facilities in ports	↑		↑								
(9) Salvage for scrap metal (dragging along seabed)	Lack of information and training for staff	↑		↑	↑							
	Poor planning and lack of CZM plan	↑			↑							
	Salvage is open access resource		↑					↑				
	No guidelines for salvage operations	↑										
Fisheries & Aquaculture	Lack of capacity for surveillance and enforcement	↑		↑								
	(10) Overfishing				↑							
	Money making livelihood and lack of alternatives				↑			↑				
	Common pool resource - tragedy of commons							↑	↑			
(11) Illegal / destructive fishing methods (e.g. dynamite, poisons, beach seines)	Overcapacity of fishery							↑	↑			
	Lack of compliances with regulations	↑			↑							
	Lack of MPAs and ICZM	↑			↑							
	Lack of monitoring, control and surveillance capacity	↑		↑								
	Increasing local demand for fish		↑									
	Increasing use of illegal / destructive methods as catches decline				↑							
	Money making livelihood and no alternative				↑							
	Competition with migrant fishers	↑						↑				
	Common pool resource - tragedy of commons							↑	↑			
	Overcapacity							↑				
	Choice of lowest cost fishing method								↑			
Access to dynamite from mining companies and home-made	↑											
Lack of compliances with regulations	↑			↑								
Lack of knowledge and awareness of best practice	↑			↑								
Lack of monitoring, control and surveillance capacity	↑			↑								
Lack of resources for enforcement				↑								
Need to be able to justify budget request for MCS				↑								
Lack of strategic plan for targeted research (to provide budget justification)				↑								

Sector and Underlying Resource Use Practice	Underlying Social, Economic, Legal and Political Causes	Root Causes									
		[A] Inappropriate governance	[B] Economic drivers	[C] Inadequate financial resources	[D] Inadequate knowledge and awareness	[E] Cultural traditions	[F] Population pressure	[G] Poverty and inequality	[H] Climate change and natural processes	[I] Voluntary action fills the governance void	[J] Personal Attitude
Agriculture & Forestry											
(5) Poor land-use practices	Lack of land-use planning	↑									
(6) Surface run-off	Lack of technical capacity	↑		↑							
Mining											
(7) Accidental release of oil due to exploration / extraction	Global market demand	↑	↑								
	Non-application or incomplete respect of international legislation	↑									
Natural environmental variability and change											
Increase in seawater temperature								↑	↑		
Ocean acidification									↑		
2.6. ...exotic non-native species, invasives and nuisance species											
Transportation and shipping											
(1) Release from ballast water	Market demand for shipping and transportation		↑								
	Increased shipping capacity and global transport	↑									
	Inadequate capacity for processing ballast water	↑		↑							
	Lack of capacity for control at entry points	↑	↑	↑	↑						
	Economic priorities	↑		↑							
	Market demand for shipping and transportation		↑								
	Increased shipping capacity and global transport	↑									
	Inadequate capacity for ship cleaning and waste disposal	↑		↑							
	Lack of capacity and technical knowledge	↑		↑	↑						
	Economic priorities	↑		↑							
Tourism											
(3) Accidental introduction of species	Expansion of tourism sector and more visitors		↑				↑				
	Lack of knowledge				↑						
	Lack of control at entry points	↑		↑							
	Lack of respect for regulations by international visitors				↑						
	Lack of compliance with customs regulations				↑						
	Lack of surveillance and enforcement capacity	↑		↑						↑	
Fisheries & Aquaculture											
(4) Deliberate introduction of species	Lack of technical capacity				↑						
	Inadequate inspection and control of mariculture facilities	↑			↑						

Sector and Underlying Resource Use Practice	Underlying Social, Economic, Legal and Political Causes	Root Causes											
(5) Accidental introduction of species	Increased global demand for seafood	[A] Inappropriate governance											
		[B] Economic drivers							↑	↑			
		[C] Inadequate financial resources											
		[D] Inadequate knowledge and awareness								↑	↑	↑	
		[E] Cultural traditions											
		[F] Population pressure											
		[G] Poverty and inequality											
		[H] Climate change and natural processes										↑	
		[I] Voluntary action fills the governance void											
		[J] Personal Attitude										↑	
Natural environmental variability and change	Inadequate inspection and control of mariculture facilities	↑											
		Negligence											
		Lack of technical capacity											
		Lack of knowledge											
Natural invasions													
Range extensions													