Annex I: Extended version of Table 3-3: Impact of important classes of threats on oceans, seas, marine resources and human well-being nexus (Extended version) *–IN PROGRESS*

Table 3-3: Impact of important classes of threats on oceans, seas, marine resources and human well-being nexus (Extended version) *–IN PROGRESS*

Climate change (caused by anthropogenic greenhouse gas emissions) **(I)**		
Impact on Oceans, Seas and Marine Resources	Illustrative scientific reports*	Further research areas suggested by contributing experts:
• Change in ocean temperature • Change in ocean salinity • Changes in stratification • Reduction of oxygen level • Increasing acidification of ocean water • Increased flooding and inundation, coastal erosion and coastal squeezing, saltwater intrusion in coastal aquifers • Melting of permafrost contributing to release of methane (enhancing greenhouse gas effect) • Decreased capacity to absorb and store greenhouse gas emissions • Decline and loss of marine species • Change in species range and survivorship due to changes in habitat and living conditions • Change in resilience and adaptation capacity • Changes in migratory patterns of fish stocks (increasingly poleward distribution of many marine species) • Degradation or destruction of marine and coastal wildlife habitats, including nesting and spawning areas and nursery grounds	• McCauley et al. (2015). Marine defaunation: Animal loss in the global ocean. • UNIDO (2015). (Contribution to GSDR). • UNOOSA (2015). (Contribution to GSDR). • Alemu and Clement (2014). Mass Coral Bleaching in 2010 in the Southern Caribbean. • Durack et al. (2014). Quantifying underestimates of long-term upper-ocean warming. • IPCC (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. • Olsson et al. (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. • Secretariat of CBD (2014). An Updated Synthesis of the Impacts of Ocean Acidification on Marine Biodiversity. • UNEP (2014). The Importance of Mangroves to People: A Call to Action. • Visbeck et al. (2014 b). A Sustainable Development Goal for the Ocean and Coasts: Global ocean challenges benefit from regional initiatives supporting globally coordinated solutions. • German Advisory Council on Global Change (WBGU) (2013). World in Transition. Governing the Marine Heritage. • Global Ocean Commission (2013). Policy Paper #2: Climate Change, ocean acidification and geoengineering. • IPCC (2013). Fifth Assessment	• Polar, Antarctic and Greenland ice sheet dynamics • Downscaling of global climate model to regions • Modelling of population change and resulting impacts on natural environment/resources • Role of ecosystems in adaptation to climate change • Ocean/climate dynamics (AMOC, PMOC, El Nino, etc.) • Increase model resolution of boundary currents, shelf circulations and mesoscale dynamics in climate projections • Establish observation programs for time series of volume and heat transport of ocean currents; Expand ocean climate observations to validate other datasets, ground truth satellite observations, verify models and improve understanding of ocean processes and heat fluxes; Monitoring of sea level rise at national/regional level (for model validation) • Long term measuring and monitoring of ocean acidification [e.g., projections of spatial and temporal variability in its progress; impacts on marine biodiversity, incl. marine food web; indirect effects (e.g. on behaviour of marine species)] • Impact on biodiversity and consequence for ecosystem functioning and stability; multispecies and food web models of climate change impacts on sustainable (re)production of marine resource; study place-based changes in species composition • Study (shifts in) distribution and abundance of indicator species and experimental transplants to recover depleted habitats • Improved economic evaluation of costs and benefits of climate change impacts on marine systems, and on their distribution • Study scope for adaptation of marine biota to climate change; identification of resilience enhancing measures • Ecological effects of emerging activities, such as ocean geo-engineering (e.g. CO_2 injection, ocean fertilization) and open ocean aquaculture • Storage and sequestration of carbon in coastal and marine ecosystems

	Report (AR5). Chapter 3. • IPCC (2013). Fifth Assessment Report (AR5). Chapter 13: Sea level change. • Juman R. and Ramsewak D. (2013). Status of Mangrove Forests in Trinidad and Tobago, West Indies. • Noone et al. (2013). Managing Ocean Environments in a Changing Climate: Sustainability and Economic Perspectives. • World Bank (2013). Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience. • Doney et al. (2012). Climate Change Impacts on Marine Ecosystems. • McClanahan et al. (2012). Prioritizing Key Resilience Indicators to Support Coral Reef Management in a Changing Climate. • Scientific and Technical Advisory Panel (STAP) (2011). Hypoxia and Nutrient Reduction in the Coastal Zone. Advice for Prevention, Remediation and Research. • World Ocean Review (2010). World Ocean Review 1: Living with the oceans. • Cheung et al. (2009). Projecting global marine biodiversity impacts under climate change scenarios. • FAO (2009). Climate Change Implications for Fisheries and Aquaculture – Overview of current scientific knowledge. • Trumper et al. (2009). The Natural Fix? The role of ecosystems in climate mitigation. A UNEP rapid response assessment. United Nations Environment Programme. • Climate Change and Biodiversity in the Insular Caribbean (CCBIC) Working Group Report (2008). Climate change impacts on coastal and marine biodiversity. • Nellemann et al. (2008). In Dead Water – Merging of climate change with pollution, over-harvest, and infestations	

	in the world's fishing grounds. • Halpern et al. (2007). Evaluating and ranking the vulnerability of global marine ecosystems to anthropogenic threats. • Hoegh-Guldberg, Ove, et al. (2007). Coral reefs under rapid climate change and ocean acidification. • Orr, James C., et al. (2005). Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. • Jeftic et al. (1996). Climatic Change and the Mediterranean: Environmental and Societal Impacts of Climatic Change and Sea-Level Rise in the Mediterranean Region, Vol. 2. • Jeftic et al. (1992). Climatic Change and the Mediterranean: Environmental and Societal Impacts of Climatic Change and Sea-Level Rise in the Mediterranean Region, Vol. 1.	
Climate change (caused by anthropogenic greenhouse gas emissions) **(II)**		
Implications for Human Well-being	Illustrative scientific reports*	Further research areas suggested by contributing experts:
• Increased vulnerability of local communities due to undermined natural protection barriers and damage or destruction of human settlements and infrastructure, including coastal transport infrastructure, services and operations (ports and other assets); loss of coastal investments; displacement of local communities • Decreased availability of freshwater • Reduced wild food fish availability - increased food insecurity and reduced sources of livelihood and employment (small-scale fisheries particularly affected) • Loss of low-lying agricultural land or homeland; decreased availability of useable/arable land • Decreased seed and feed availability for aquaculture as alternative livelihood - decreased productivity undermining food security • Reduced attractiveness of destination and quality of tourist experience –reduced sources of employment and revenue • Increase of vector-borne (e.g. through mosquitoes and marine invertebrates) and water borne diseases (contact with contaminated water/food) in coastal areas	• FAO (2014). Climate Change Adaptation in Fisheries and Aquaculture. • High-level Panel of Experts on Food Security and Nutrition (2014). Sustainable fisheries and aquaculture for food security and nutrition. • IAEA (2014). The Atom, the Environment and Sustainable Development. • IDB (2014). Understanding the economics of climate adaptation in Trinidad and Tobago. • IPCC (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. • Fanning et al. (2013). Applying the large marine ecosystem (LME) governance framework in the wider Caribbean region. • Mills et al. (2013). Developing Timor-Leste's coastal economy: Assessing potential climate change impacts and adaptation options. Final	• Long-term monitoring and related integrative research (e.g. climate change and conflict) • Coastal vulnerability assessments • Develop realistic projections of impacts on communities, including climate-induced migration • Identify ways to enhance resilience of communities; (cost benefit) analysis of adaptation measures/strategies, including specific strategies for vulnerable groups • Research on how ecosystem based adaptation, and adoption of low cost good practices can reduce risks (and costs) of climate change impacts • Equity effects of climate change • Identification of high priority coastal ecosystems for protection and restoration to reduce coastal community vulnerability • Effect of on tourism sector in coastal areas • Assess vulnerability of coastal transport infrastructure, services and operations (ports and other assets) at local level • Conduct research on gender-specific impacts of climate change

	report to the Australian Government Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security National Initiative. • Ruckelshaus et al. (2013). Securing ocean benefits for society in the face of climate change. • Shah et al. (2013). Understanding livelihood vulnerability to climate change: Applying the livelihood vulnerability index in Trinidad and Tobago. • WMO (2013): The Global Climate 2001-2010: A Decade of Climate Extremes. • World Bank (2013). Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience. • FAO/OECD (2012). Building resilience for adaptation to climate change in the agriculture sector. Proceedings of a Joint FAO/OECD Workshop. • Nursey-Bray et al. (2012). Communicating climate change: Climate change risk perceptions and rock lobster fishers, Tasmania. • UNDP (2012). Catalysing Ocean Finance (Volumes I & II). • ECLAC (2011a). An assessment of the economic impact of climate change on the agriculture sector in Trinidad & Tobago. • ECLAC (2011b). An assessment of the economic impact of climate change on the energy sector in Trinidad & Tobago. • Cheung et al. (2010). Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change. • Mycoo, M., & Sutherland, M. (2010). Climate change and physical development threats, challenges and adaptation responses in coastal communities: Grand Riviere, Trinidad. • Fanning et al (2009). Focusing on living marine resource	

	governance: the Caribbean large marine ecosystem and adjacent areas project. • Multiagency Policy Brief (2009). Fisheries and Aquaculture in our Changing Climate. • Bueno et al. (2008). The Caribbean and Climate Change: The costs of inaction. • Dilley, M., & Boudreau, T. E. (2001). Coming to terms with vulnerability: a critique of the food security definition.	
Marine pollution from marine and land-based sources (I)		
Impact on Oceans, Seas and Marine Resources	Illustrative scientific reports*	Further research areas suggested by contributing experts:
• Creation of low oxygen "hypoxic" conditions, harmful algal blooms and dead zones and changes of ecosystems due to eutrophication • Decreased sea water quality • Accumulation of toxins in food web • Contamination with toxic chemicals causing illnesses or death of marine species • Spilled oils affecting animals and plants both from internal exposure (ingestion or inhalation) and from external exposure (skin and eye irritation) (e.g. reducing ability to maintain body temperatures) • Decline and loss of marine species • Degradation or destruction of marine and coastal wildlife habitats, including nesting and spawning areas and nursery grounds • Potential effects on growth, reproduction and trophic interactions, including effect of hormones and pharmaceuticals in watersheds on estuaries and coastal animal populations • Alien invasive species may outcompete local marine species and threaten marine food web	• UN World Ocean Assessment (2015)[1] • UNEP (2014). Plastic Debris in the Ocean. • UNEP (2014). Valuing plastic - The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry. • Global Ocean Commission (2013). Policy Paper #3: Elimination of pollution that affects the high seas. • UNEP (2013). Regional Plan on Management of Marine Litter in the Mediterranean. • Wright et al. (2013).The physical impacts of microplastics on marine organisms: a review. • GESAMP Reports and Studies No. 84 (2012). The Atmospheric Input of Chemicals to the Ocean. • GESAMP Working group 40: Report of the Inception Meeting, IOC-UNESCO (2012). Sources, fate and effects of micro-plastics in the marine environment-a global assessment. • Secretariat of CBD (2012). Scientific Synthesis of the Impacts of Underwater Noise on Marine and Coastal Biodiversity and Habitats. • Burke et al. (2011). Reefs at risk revisited. World Resources Institute. • IUCN (2010). Marine Menace: Alien invasive species in the marine environment.	• Census of heavily populated areas with important industrial activities and fisheries; mapping of risk areas where industries that discharge materials are located • Better understanding of ecology of pollution impacts and quantification of impacts, especially extrapolating from individual impacts to population and ecosystem impacts • Cumulative and/or simultaneous impact of multi-stress factors on marine and coastal ecosystems • Link between marine coastal ecosystem change and occurrence of harmful algae blooms and dead zones/hypoxia • Impact of contaminants of emerging concern (e.g. from micro-plastics, pharmaceuticals, personal care products, ethylene dichloride) • Impact of nanomaterials on biota • Linking terrestrial and coastal/marine policies to address pollution from land-based sources • Impacts of underwater noise • Depollution techniques and pollution preventive measures • Pathways and fate of contaminants (especially, POPS, heavy metals and microplastics) into marine environments • Ecological threshold of contaminants or water quality standards for ecosystem functioning and stability • Understanding the extent and effects of alien invasive species (lags behind that for terrestrial invasive species) • Economic assessment of impact of alien invasive species on coastal and marine environment, including deep and open oceans • Effectiveness of eradication programs for alien invasive species • Cascading effects of alien invasive species on marine food web and ecosystem functioning and stability

	• Mouat et al. (2010). Economic Impacts of Marine Litter. • CEP (2009). Marine Litter in the Caspian Region. Review and Framework Strategy. • GESAMP Reports and Studies No. 79 (2009). Pollution in the open oceans: a review of assessments and related studies. • HELCOM (2009). Marine Litter in the Baltic Sea Region. Assessment and priorities for response. • UNEP (2009). Marine Litter: A Global Challenge. • UNEP MAP/MEDPOL (2009). Marine Litter in the Mediterranean Region. • GESAMP (2009). Pollution in the open oceans: a review of assessments and related studies. • OSPAR (2009). Marine litter in the North-East Atlantic Region: Assessment and priorities for response. • Diaz, Robert J., and Rutger Rosenberg (2008). Spreading dead zones and consequences for marine ecosystems. • NOWPAP (2008). Marine Litter in the Northwest Pacific Region. • GESAMP Reports and Studies No. 75 (2007). Estimates of Oil Entering the Marine Environment from Sea-based Activities. • Islam, Md. and Tanaka, M. (2004). Impacts of pollution on coastal and marine ecosystems including coastal and marine fisheries and approach for management: a review and synthesis. • Derraik, Jose GB (2002). The pollution of the marine environment by plastic debris: a review. • UNEP/MAP/MEDPOL (1996): Assessment of the state of eutrophication in the Mediterranean.	

Marine pollution from marine and land-based sources (II)		
Implications for Human Well-being	Illustrative scientific reports*	Further research areas suggested by contributing experts:
• (Increase of) health hazards such as: - freshwater pollution; - human intoxication/poisoning (e.g. toxins in fish and shellfish); - accumulation of plastic nanoparticles in food web - degradation of bathing water quality; - skin diseases from exposure; • Displacement of local communities (by cases of pollution which make economic activities inviable for years or decades) • Decrease in attractiveness of destination for tourists – decrease in related job opportunities and revenues • Decreased wild food fish availability - significant loss of food supply and income • Decrease in coastal real estate value (e.g. due to unhealthy water quality and/or degraded landscape/seascapes) • Decreased seed and feed availability for aquaculture as alternative livelihood - decreased productivity undermining food security • Introduction of alien invasive species reduces or potentially causes disappearance of commercial or food-important marine resources • Increased spread of diseases as a result of harmful algae blooms worsened by alien invasive species • Direct and indirect impacts on coastal transport infrastructure, services and operations (ports and other assets), including fouling of marine infrastructure caused by alien invasive species • Threat to navigation and safety at sea through abandoned, lost and otherwise discarded fishing gear (ALDFG)	• UN World Ocean Assessment (2015)[2] • UNEP (2013). Regional Plan on Management of Marine Litter in the Mediterranean. • Ngah et al. (2012). Marine pollution trend analysis of tourism beach in Peninsular Malaysia. • Hester and Harrison (2011). Marine Pollution and Human Health. • Teicher S. (2011). The Chesapeake Bay Dead Zone: Causes, Consequences, and Goals for Management. • Corcoran et al. (2010). Sick Water? The central role of wastewater management in sustainable development. • Mouat et al. (2010). Economic Impacts of Marine Litter.	• More marine ecosystem evaluation studies • Quantification of socioeconomic impacts • Economic evaluation of waste water treatment plants • Aggregate effects of marine pollution on food quality and health • Health implications of microplastic ingestion • More studies about successful participatory coastal rehabilitation projects and on ways to replicate them • Effects of visual marine pollution on destination choice made by the tourists • Agricultural development and pollution from land-based sources and activities (LBS) • Impact of contaminants on human health • Impacts of harmful algal blooms on human health • Externalities resulting from port activities (air pollution, noise, land use, dredging costs and impact on environment, etc.) • Socio-economic impact of specific alien invasive species invasions • Potential use of alien invasive species for livelihoods (e.g. lionfish)
Unsustainable extraction of marine resources (I)		
Impact on Oceans, Seas and Marine Resources	Illustrative scientific reports*	Further research areas suggested by contributing experts:
• Decline and loss of marine species – threatening marine food web and overall ecosystem functioning and stability • Changes in ecological interactions between species with unpredictable consequences for food web and ecosystem functioning and stability • Capturing and mortality of non-target species (by-catch), including endangered, threatened and protected • Damage and/or destruction of critical and vulnerable fishing grounds and marine and coastal habitats • Degradation of water quality	• UN World Ocean Assessment (2015)[3] • Christensen et al. (2014). A century of fish biomass decline in the ocean. • FAO (2014). The State of World Fisheries and Aquaculture - Opportunities and Challenges. • Gilman et al. (2014). Performance of regional fisheries management organizations: ecosystem-based governance of bycatch	• Environmental impacts of deep sea mining and adequacy of environmental management approaches and regulatory regimes • Better quantification of spatial extent of bottom trawling (and uses of other gears such as gill nets) • Rehabilitation of depleted invertebrate wild stock • Research on properties that make marine ecosystems resilient (or lose resilience)

	and discards. • UNEP (2014). Wealth in the Oceans: Deep sea mining on the horizon? • WWF (2014). Living Planet Report 2014: Species and spaces, people and places. • Global Ocean Commission (2013). Policy Paper # 6: Elimination of harmful fisheries subsidies affecting the high seas. • Global Ocean Commission (2013). Policy Paper #8: Illegal, unreported and unregulated fishing. • Gómez et al. (2013). Regional Strategy for the Control of Invasive Lionfish in the Wider Caribbean. • World Ocean Review (2013). World Ocean Review 2: The Future of Fish –The Fisheries of the Future. • Worm et al. (2013). Global catches, exploitation rates, and rebuilding options for sharks. • Costello et al. (2012). Status and Solutions for the World's Unassessed Fisheries. • E.K. Pikitch (2012). The Risks of Overfishing. • Martell and Froese (2012). A simple method for estimating MSY from catch and resilience. • Rayfuse R. (2012). Precaution and the Protection of Marine Biodiversity in Areas beyond National Jurisdiction. • Sumaila et al. (2012). Benefits of rebuilding global marine fisheries outweigh costs. • UNEP, FAO, IMO, UNDP, IUCN, World Fish Center, GRID-. Arendal (2012). Green Economy in a Blue World. • Branch et al. (2011). Contrasting Global Trends in Marine Fishery Status Obtained from Catches and from Stock Assessments. • Gilman, E. (2011). Bycatch governance and best practice mitigation technology in global tuna fisheries. • Branch et al. (2010). The trophic fingerprint of marine	

	fisheries. • FAO - Gilman, E., Bianchi, G. (2010). Guidelines to Reduce Sea turtle Mortality in Fishing Operations. FAO Technical Guidelines for Responsible Fisheries. Food and Agriculture Organization of the United Nations, Rome. • Flothmann et al. (2010). Closing Loopholes: Getting Illegal Fishing Under Control. • IUCN (2010). Marine Menace: Alien invasive species in the marine environment. • Sumaila et al. (2010). A bottom-up re-estimation of global fisheries subsidies. • Sumaila et al. (2010). Subsidies to high seas bottom trawl fleets and the sustainability of deep-sea demersal fish stocks. • Agnew et al. (2009). Estimating the Worldwide Extent of Illegal Fishing. • Davies et al. (2009). Defining and estimating global marine fisheries bycatch. • Macfadyen et al. (2009). Abandoned, lost or otherwise discarded fishing gear. • Danovaro et al. (2008). Exponential decline of deep-sea ecosystem functioning linked to benthic biodiversity loss. • Molnar et al. (2008). Assessing the global threat of invasive species to marine biodiversity. • Byrnes (2007). Invasions and Extinctions Reshape Coastal Marine Food Webs. • Clark and Koslow (2007). Impacts of fisheries on seamounts. In: Seamounts. • OECD High Seas Task Force (2006). Closing the net: Stopping illegal fishing on the high seas. • Kelleher, K. (2005). Discards in the World's Marine Fisheries: An Update. Food and Agriculture Organization of the United Nations. • Myers, R.A. and Worm, B. (2005). Extinction, survival or recovery of large predatory	

	fishes. • Pauly, D. and M.L. Palomares (2005). Fishing down marine food webs: it is far more pervasive than we thought. • Pimental et al. (2005). Update on the environmental costs associated with alien invasive species in the United States. • Bax et al. (2003). Marine invasive alien species: a threat to global biodiversity. • Myers, R.A. and Worm, B. (2003). Rapid worldwide depletion of predatory fish communities. • Coleman, F. and Williams, S. (2002). Overexploiting marine ecosystem engineers: potential consequences for biodiversity. TRENDS in Ecology and Evolution 17: 40-44. • Pauly et al. (2002). Towards sustainability in world fisheries. • Pauly et al. (1998). Fishing down marine food webs.	
Unsustainable extraction of marine resources (II)		
Implications for Human Well-being	Illustrative scientific reports*	Further research areas suggested by contributing experts:
• Decreased wild food fish availability - significant loss of food supply and income • Decrease in attractiveness of destination for tourists – decrease in related job opportunities and revenues • Possible displacement of local communities by abusive or unregulated extraction of resources (e.g. reduced fishing opportunities generating internal or external migration flows) • Unacceptable working conditions affecting fishers and fish workers; child labor • Decreased seed and feed availability for aquaculture as alternative livelihood - decreased productivity undermining food security	• UN World Ocean Assessment (2015)4 • FAO (2015). Fisheries and aquaculture – promoting decent work as a strategy for responsible fishing. (Contribution to GSDR) • FishWise (2014). Trafficked II: An updated summary of human rights abuses in the seafood industry. • High-level Panel of Experts on Food Security and Nutrition (2014). Sustainable fisheries and aquaculture for food security and nutrition. • UNCTAD (2014). The fisheries sector in the Gambia: trade, value addition and social inclusiveness, with a focus on women. • UNCTAD (2014). The Oceans Economy: Opportunities and Challenges for Small Island Developing States. • Howarth et al. (2013). The unintended consequences of	• Systematic assessment of poverty dimensions associated with livelihoods in fisheries and aquaculture • Estimated value of fisheries beyond value of fish resources or harvest sector • Impact of IUU fishing on local communities (e.g. significant loss of income); link between IUU fishing and unacceptable working conditions • Identification of most suitable options for sustainable fish farming, especially in developing countries • Social (employment) versus economic (profit) trade-offs in uses of living marine resources • Costs and benefits of shift to more sustainable practices

	simplifying the sea: making the case for complexity. • Teh, C.L.L. and U.R. Sumaila (2013). Contribution of marine fisheries to worldwide employment. • World Bank Report (2013). FISH TO 2030, Prospects for Fisheries and Aquaculture. • Srinivasan et al. (2012). Global fisheries losses at the exclusive economic zone level, 1950 to present. • Uilapesca-Cres (2012). IUU Fishing and its Relation to the Rights of Fishworkers in International Law. • UNEP, FAO, IMO, UNDP, IUCN, World Fish Center, GRID-. Arendal (2012). Green Economy in a Blue World. • Gallagher, A.J. and N. Hammerschlag (2011). Global shark currency: the distribution, frequency, and economic value of shark ecotourism. • Dyck and Sumaila (2010). Economic impact of ocean fish populations in the global fishery. • Agnew et al. (2009). Estimating the Worldwide Extent of Illegal Fishing. • The World Bank and FAO (2009). The Sunken Billions: The Economic Justification for Fisheries Reform. • UNEP (2008). Fisheries Subsidies: A Critical Issue for Trade and Sustainable Development at the WTO. • Cox, A. (2006). Financial Support to Fisheries: Implications for Sustainable Development. • Sumaila et al. (2006). Global scope and economics of illegal fishing. • Worm et. al. (2006). Impacts of Biodiversity Loss on Ocean Ecosystem Services. • Marine Resources Assessment Group Ltd (MRAG) (2005). Review of Impacts of Illegal, Unreported and Unregulated Fishing on Developing Countries.	

Physical alterations and destruction of marine and coastal habitats and landscapes (I)		
Impact on Oceans, Seas and Marine Resources	Illustrative scientific reports*	Further research areas suggested by contributing experts:
• Decline and loss of marine species • Destruction, displacement or alteration of marine and coastal wildlife habitats, including nesting and spawning areas and nursery grounds • Impact on ecosystem functioning and stability • Impact on shorelines and coastal stability; coastal erosion • Alteration of microbial structure and biogeochemistry, including greenhouse gas cycles	• United Nations World Ocean Assessment (2015)[5] • Liu and Su (2015). Vulnerability of Nearshore Ecosystems from Rapid Intensive Coastal Development. (Contribution to GSDR) • Villarroel-Lamb, D. (2015). The Role of the Engineer in the Preservation of the Coastal Environment. (Contribution to GSDR) • Continental Shelf Research (2014). Special Issue on "Geoscience and habitat mapping for marine renewable energy". • Newton, A. and Weichselgartner, J. (2014). Hotspots of coastal vulnerability: A DPSIR analysis to find societal pathways and responses. • United Nations World Tourism Organization (2014). Towards measuring the economic value of wildlife watching tourism in Africa. • Wang et al. (2014). Development and management of land reclamation in China. • World Ocean Review (2014). World Ocean Review 3: Marine Resources – Opportunities and Risks. • IMO (2013). International Assessment of Marine and Riverine Disposal of Mine Tailings. • Juman R. and Hassanali K. (2013). Mangrove conservation in Trinidad and Tobago. • Juman R. and Ramsewak D. (2013). Land cover changes in the Caroni Swamp Ramsar Site, Trinidad (1942 and 2007): implications for management. • Hernandez-Delgado et al. (2012). Long-Term Impacts of Non-Sustainable Tourism and Urban Development in Small Tropical Islands Coastal Habitats in a Changing Climate: Lessons Learned	• Evaluation and mapping (in multiple terms) of coastal ecosystems • Impact of underwater noise • Systematic assessment of deep-sea ecosystems • Specific impacts of physical alterations on marine and coastal ecosystems and resilience of affected ecosystems • Ecological effects of emerging activities, such as ocean geo-engineering (e.g. CO2 injection, ocean fertilization), renewable energy and open ocean aquaculture • Study tourism operators and land developers' level of involvement and concern in nature conservation • Release of carbon from coastal ecosystems by physical alteration and land use change • Impacts of eroded sand from beach nourishment on benthic communities

	from Puerto Rico. Visions for Global Tourism Industry - Creating and Sustaining Competitive Strategies. • Beck et al. (2009). Shellfish Reefs at Risk: A Global Analysis of Problems and Solutions. • Heifetz et al. (2009). Damage and disturbance to coral and sponge habitat of the Aleutian Archipelago. • OSPAR Commission (2009). Assessment of the environmental impacts of cables. • Yanagisawa, H., et al. (2009). The reduction effects of mangrove forest on a tsunami based on field surveys at Pakarang Cape, Thailand and numerical analysis. • Bozec et al. (2008). Impacts of coastal development on ecosystem structure and function of Yucatan coral reefs, Mexico. • Halpern et al. (2008). A global map of human impact on marine ecosystems. • Hall, C.M. (2001). Trends in ocean and coastal tourism: the end of the last frontier?	
Physical alterations and destruction of marine and coastal habitats and landscapes (II)		
Implications for Human Well-being	Illustrative scientific reports*	Further research areas suggested by contributing experts:
• Decreased wild food fish availability - threatening food security • Increased vulnerability of local communities due to undermined natural protection barriers and degradation and destruction of coastal settlements • Reduced attractiveness of destination and quality of tourist experience –reduced sources of employment and revenue • Loss of access to marine and coastal resources for livelihoods and recreation (e.g. hotel resorts not allowing passage to beach) - affecting food security and income (small-scale fisheries) • Decreased seed and feed availability for aquaculture as alternative livelihood • Displacement of communities	• Hassanali K. (2013). Towards sustainable tourism: The need to integrate conservation and development using the Buccoo Reef Marine Park, Tobago, West Indies. • Burke et al. (2012). Reefs at Risk Revisited in the Coral Triangle. World Resources Institute • Burke et al. (2011). Reefs at risk revisited. World Resources Institute. • Edwards (2009). Measuring the Recreational Value of Changes in Coral Reef Ecosystem Quality in Jamaica: The Application of Two Stated Preference Methods. • Whitmarsh et al. (2003). The economic sustainability of artisanal fisheries: the case of the trawl ban in the Gulf of	• Evaluation of impacts of physical alterations on marine and coastal ecosystems and subsequent effects on communities • Adaptive capacity of coastal communities • Development of ecosystem-based solutions for coastal defence and “hybrid-engineering” • Cost benefit analysis of coastal development

	Castellammare, NW Sicily. • White et al. (2000). Philippine Coral Reefs under Threat: The Economic Losses Caused by Reef Destruction. • Bunce, L. and K. Gustavso (1998). Coral reef valuation: A rapid socioeconomic assessment of fishing, watersports, and hotel operations in the Montego Bay Marine Park, Jamaica and an analysis of reef management implications. • UNEP (1996). Guidelines for Integrated Planning and Management of Coastal and Marine Areas in the Wider Caribbean Region.	

[1] http://www.worldoceanassessment.org/
[2] http://www.worldoceanassessment.org/
[3] http://www.worldoceanassessment.org/
[4] http://www.worldoceanassessment.org/
[5] http://www.worldoceanassessment.org/