Regional Scientific and Technical Capacity Building Workshop on the World Ocean Assessment

Bangkok, Thailand 17–19 September 2012

Workshop report: South China Sea

Citation
Ward, Trevor J., 2012. Workshop Report: Regional Scientific and Technical Capacity Building Workshop on the World Ocean Assessment (Regular Process), Bangkok, Thailand. 17–19 September 2012. UNEP/COBSEA, Bangkok October 2012.

Acknowledgements
The material contained in this report was freely provided by the experts who attended the workshop. It has been interpreted and summarized by the workshop moderator in conjunction with the organizing group. The summary and findings represent the aggregated judgment and broad consensus of the experts and no individual finding or outcome of this workshop can be attributed to a single expert. The organizing group is very grateful for the participation and inputs of the experts named in this report, without whom the workshop could not have been conducted.

Cover image
South China Sea, photo by Dr Ellik Adler

Report available for download from:
http://www.worldoceanassessment.org

Regional Scientific and Technical Capacity Building Workshop on the World Ocean Assessment

Bangkok, Thailand 17–19 September 2012

Workshop report: South China Sea

Report prepared by Dr. Trevor Ward, Workshop Moderator, University of Technology, Sydney; and Greenward Consulting, Perth, Australia

Organising Group: Dr. Ellik Adler, UNEP/COBSEA, Dr. Elaine Baker, GRID Arendal, Dr. Peter Harris, Geoscience Australia, Dr. Alexander Tkalin, UNEP/NOWPAP, Mr. Wenxi Zhu, UNESCO/IOC/WESTPAC

Executive Summary	4
Background	5
Description of the Workshop	6
Workshop Outcomes	8
Regional Overview of Condition: An Integrated Assessment	11
Amendments to the Methodology	17
Description of the Workshop	18
Conclusions and Recommendations	21
Annexes	23
Annex 1: List of participants	24
Annex 2: Provisional Workshop Agenda	27
Annex 3: Workshop Methodology	29
Annex 4: Analysis Examples	45
Annex 5: Worksheets Completed by the Experts	51

Executive Summary

In large marine regions undertaking integrated assessments can be expensive and time consuming, but sound information is critical to understanding the state of the marine environment and achieving or maintaining ocean health. Most importantly, such large scale and integrated assessments must not be overly influenced by information that is limited only to either places or issues that are well studied, since this might result in outcomes that are not balanced or properly represent conditions across the whole of a region. The purpose of the workshop held in Bangkok (17-19 September, 2012), was to build capacity to undertake regional integrated marine assessments. A previous workshop, to support the United Nations World Ocean Assessment, held in Sanya City China, identified a regional capacity gap in this area.

The workshop utilized a methodology for a rapid regional ocean assessment and applied it to the South China Sea (SCS). The workshop included an evaluation of the assessment methodology and its potential effectiveness in producing a credible assessment, for the region and also for national jurisdictions. The participants used the methodology to produce an indicative assessment of biodiversity and ecosystem health in the SCS.

The workshop methodology was based on an expert elicitation process – a process that synthesises the subjective judgement of experts across a broad base of evidence. Expert elicitation is essentially a scientific consensus methodology. In this case, the process consisted of three phases: 1) a pre-workshop review to select the assessment parameters, such as habitats, species and processes; 2) the choice of a reference point or benchmark (the year 1900) against which the assessment of current conditions would be compared; and 3) the development of a scoring system and guiding rules to be used throughout the assessment including definitions for the assigned condition and the definition of time frames, so that trends in the assessment of condition could be included (current was defined as the period 2007-2012 and future, 2012-2017).

The participants considered the aspects of biodiversity, ecosystem health and pressures and assigned grades to their condition and trend. In all, 104 parameters were considered and given a score from 1 to 10 describing the condition, and a grade for trend (declining, stable or improving) and confidence level assigned to the judgment (low, medium, high). Where possible, the expert judgments were supported by published assessments and relevant data syntheses.

A preliminary analysis of the workshop scores has been undertaken. The median score for all of the 69 biodiversity parameters assessed across the SCS indicated that the experts considered that in the Best 10% of places the biodiversity of the region is in Good condition, and approaching the Very Good grade. However, for Most places, representing a notional 80% of the biodiversity of the region, the condition was graded as Poor; and in the Worst 10% of places the condition was graded as Very Poor. The experts assigned these scores with an average confidence level of 1.7, which equates to a level between High and Medium confidence.

The median score for the 27 ecosystem health parameters (indicators such as presence of pests, disease etc) in the Best 10% of places/occurrences/populations in the region was considered to be Very Good, Good in Most places, and Poor in the Worst 10% of places. The experts assigned these scores with an average confidence level of 1.6, which equates to a level between High and Medium confidence.

The combined impacts of the eight pressures scored in this exercise were assessed as resulting in Poor condition in Most places — the notional 80% of the area of the biodiversity and ecosystems of the SCS that were considered.

In general, it was found that the workshop methodology could be used to build a formal (i.e. well-developed, structured, systematic, transparent, traceable and documented) expert elicitation procedure that can be used on both a regional and national scale to produce a rapid integrated marine assessment. Participants agreed with the need to find a good spread of experts with relevant knowledge and experience in order to make good integrated judgments, and as part of the process to provide and document key supporting evidence for the judgements.

Background

Following the recommendations made at the workshop for Eastern and South-Eastern Asian Seas convened from 21 to 23 February 2012 in Sanya, China, held under the auspices of the United Nations, in support of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socio-economic Aspects (now referred to as the World Ocean Assessment, WOA) (Annex 15 of the final report), a technical capacity-building workshop ("the Workshop") was conducted in Bangkok on 17-19 September 2012. This workshop was focused on building capacity to prepare integrated assessments, using the South China Sea (SCS) region as an example.

The Workshop was organized by GRID-Arendal (GA), the United Nations Environment Programme (UNEP COBSEA and NOWPAP), UNESCO/IOC Sub-Commission for the Western Pacific (IOC/WESTPAC) with funding support from the Asia-Pacific Network for Global Change (APN), IOC/WESTPAC and UNEP.

Dr Trevor Ward acted as the moderator. The participants included marine scientific experts from Cambodia, China, Indonesia, Japan, Republic of Korea, Malaysia, Philippines, Russia, Singapore, Thailand and Vietnam. Also attending the workshop were members of the United Nations World Ocean Assessment Group of Experts from Australia (Dr. Peter Harris), China (Dr. Juying Wang), Korea (Dr. Chul Park) and the United Kingdom (Mr. Alan Simcock). Representatives of the following United Nations agencies, offices and programmes also participated in the Workshop: UNESCO/IOC Sub-Commission for the Western Pacific (IOC/WESTPAC); the Coordinating Body on the Seas of East Asia (COBSEA) of UNEP; GRID-Arendal, the Northwest Pacific Action Plan (NOWPAP) of UNEP, and FAO.

The list of participants, observers and support staff is attached (Annex 1).The Provisional Workshop Agenda that guided the technical workshop through the deliberations is also attached (Annex 2).

Description of the Workshop

The objectives of the workshop were twofold:

1. Provide capacity building to conduct a rapid marine assessment, encouraging review, questioning and real-time revision of the assessment process in order to develop a common understanding among participants of the most effective forms of rapid assessment for the region - including knowledge about how to scale the pilot assessment down to national jurisdictions.
2. Conduct a pilot assessment, which demonstrates how to conduct a rapid assessment of the condition of biodiversity across a region as large and complex as the SCS, and produces an assessment that supports the development of efficient and effective policy and programmes to enhance biodiversity in the region.

These two objectives, taken together, are expected to build the capacity of regional and national organizations and authorities to conduct similar assessments in a manner that is coherent across the region and consistent with the spirit of the WOA.

The pilot rapid assessment process for the SCS, tested by the experts at this workshop, used systematic and consistent methodology that minimises the risk of bias and enables the capture and reporting of information that is relevant to the region and likely to be useful for the WOA. The approach used here has been adapted from a number of earlier procedures used for similar purposes,, including, projects of the International Waters Program of GEF, including the GIWA Regional Assessment 54 for the South China Sea [http://www.unep.org/dewa/giwa/publications/r54.asp].

The assessment consisted of three phases: 1) a pre-workshop review of the decision structure, parameters and assumptions/constraints; 2) the attendance at the workshop by invited experts to evaluate the components of the pilot assessment methodology, and secure their consensus on grades, scores and confidence; and 3) a short post-workshop period for refinements and updates before issuing a final summary report on the workshop and its outcomes.

Phase 1 – Pre-Workshop Phase

Prior to the workshop, the participating experts received (by e-mail) a summary of the assessment methodology so that the dynamics and the process of the workshop could be well understood before they arrived in Bangkok.

Participants also received six draft (electronic) worksheets that they were requested to use to provide their initial input and commentary. The working templates for their consideration/confirmation included the following elements:

1. The list of specific parameters of the region to be considered at the workshop (such as the region's major habitat types as well as the important attributes of those habitats to be incorporated into the assessment, including any areas of special environmental significance);
2. Any unique reference points for condition (e.g. the condition of habitats in the early 1900s) against which current status assessments will be made;
3. Grading statements to be used to provide system-wide guidance about setting levels of performance (such as what is meant by 'Very Good'); and
4. The timeframes considered to be appropriate for this assessment (such as 'current' is the period 2007–2012).

The participants were asked to return completed worksheets by email within two weeks. Responses were compiled by the workshop organisers into a single draft set, for final review at the beginning of the workshop. To make the workshop process efficient, the participants received a copy of the compiled draft worksheets prior to their arrival in Bangkok.

Phase 2 – The Workshop

At the workshop, participants were guided to provide their expert judgement on indicators of condition and trends in biodiversity and ecosystem health and in the importance of the main threats and pressures affecting the marine ecosystems. During the workshop, the grading process involved a mix of plenary discussion and discussion in small sub-groups, so that experts could discuss and agree on the scores assigned to each indicator. Estimates of uncertainty were also ascribed by the experts to condition grades, and this was used to provide a measure of confidence in the grading outcomes for each condition assigned to an environmental component.

Condition: the condition of each assessed parameter used one of four performance grades (Very Poor, Poor, Good or Very Good) assigned to each of three spatially-based indicators (Best10%, Most, Worst10%; see below). Each of the grades was divided into a subset of numeric scores (Figure 1). The numeric data provided the basis for compilation of region-wide summaries, and to gauge uncertainty in the estimates of condition. The numeric scoring also enabled the experts to provide marginal refinements within each of the 4 classes (e.g. assigning a score to the top – or bottom – of a grade, where enough detailed information was available). The scores also enabled a numerically based aggregation of condition estimates and the confidence assessments. Although there is a numeric basis for estimating each parameter and indicator, assessment accuracy finer than one grade is not inferred, and results for the overall regional assessment of condition are only interpreted and presented in the context of the four performance grades.

Uncertainty surrounding condition was estimated by the experts in three grades of confidence: High, Medium or Low. These grades were guided by the following rules: High confidence in a condition estimate infers that the condition score is highly unlikely to fall outside one grade, or an equivalent distance; Medium confidence infers that the condition estimate is highly unlikely to fall outside two grades; and Low confidence infers that the condition estimate is highly unlikely to fall outside three grades. In the numeric aggregation of confidence these grades were assigned as confidence levels of 1.2, 2.4 and 3.5 performance units respectively (approximating an estimate of the 95% Confidence Limits).

Indicators: the three indicators for which scores/grades were assigned by the experts were Best10%, Most, and Worst10%. The scores for each of these indicators were determined by reference to the notional (or actual data where they exist) frequency distribution of a spatial set of condition scores related to the parameter being assessed. The exact meaning of this is slightly different across the set of parameters, but is always interpreted as a spatial construct of the condition elements being assessed. For habitats, for example, the indicators refer to the spatial distribution of the condition (which may be estimated as, for example, a combination of structural and functional intactness) across the region, where the habitat either does occur, has or occurred or could occur. Equivalent constructs apply to species, ecological processes, and the other components mentioned above. The methodology provided specific guidance to the experts on how to consistently interpret and apply this scoring system.

Trends in Condition: estimation of trends in each parameter was accomplished also using three grades: Improving, Stable or Declining, referring to the current (2007-2012) condition status. Confidence in the assignment of a trend was also assessed using the High, Medium or Low categories as for condition. However, since the trends did not involve a numeric assessment basis, the confidence estimates were summarised simply as the relative proportion of the class to the total number of confidence estimates made across each dataset of trends.

Accuracy of the Outcomes: where experts in a subgroup or in plenary were unable to assign a grade because of a lack of adequate knowledge, either because an appropriate expert was not available to attend the workshop or there was an acknowledged major knowledge gap, then condition/confidence estimates were not assigned. These situations were treated throughout the workshop as missing data, and they have no influence on the region-wide outcomes of the expert assessment of condition or trends. Distinguishing between these two situations (no relevant expert at the workshop; not enough data/knowledge or adequate resolution to make a judgement) is important for assessment of data gaps, but was not the focus of this workshop. While such lack of information does limit the resolving power (accuracy) of the outcomes from this workshop, it does not degrade the quality of the outcomes that have been achieved, since this same bias is evident in all forms of assessment. Here, these gaps are made explicit, and the resolving power is limited to the defined assessment construct of the decision methodology and the four coarse performance grades. This level of resolution has been chosen to best match the capabilities of a rapid assessment process, and the likely capacity of experts from regions of the size and complexity of the South China Sea (SCS) to be able to attend and contribute their knowledge.

A more detailed summary of the approach and methodology used to guide the workshop can be found in Annex 3..

Phase 3 – Post-Workshop

The summary outcomes of the workshop were circulated back to participants for a short period to allow for any necessary checking and updating. This report provides a platform for further focus and improvement of the assessment process.

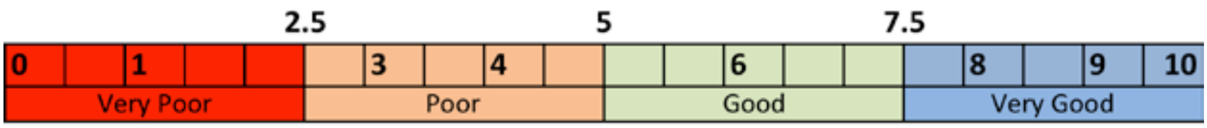


Figure 1. Graphical representation of the condition grades and associated numeric scoring structure.

Workshop Outcomes

The workshop considered the following components of biodiversity, ecosystem health and pressures, and assigned grades to their condition and trends in the South China Sea region.

Biodiversity
Habitat Quality (24 parameters)
Species and Groups of Species (32 parameters)
Ecological Processes (13 parameters)
Ecosystem Health
Physical and Chemical Processes (18 parameters)
Pests, Invasive Species, Diseases and Algal Blooms (9 parameters)
Pressures (8 parameters)
Climate Change and Variability
River Discharges
Coastal Urban Development
Coastal Wetland Development
Land Reclamation
Fishing
Aquaculture (on-shore ponds and sea-cages)
Eutrophication from Coastal Sources
Extreme Climate Events*
Island Development for Tourism*
Port Facilities*
Oil and Gas Exploration and Production*
Power Generation*
Foreshore Protection with Hard Substrates*
Mining and Associated Infrastructure*

**These seven pressures were considered by the experts, but were unable to be scored in a manner consistent with the scoring and grading of the workshop methodology, or, only very limited data and information were available from the experts in attendance. Hence these pressures have not been included in the scoring or graphical summary of pressures.*

The scoring matrices (in summary form) as completed by the experts at the workshop are attached at Annex 5.

Summary of Scoring Outcomes

To summarise the outcomes of the condition assessments, the data provided by the experts at the workshop have been aggregated into three groups: biodiversity (comprising the 69 scored parameters in habitat quality; species and species groups; and ecological processes), ecosystem health (comprising the 27 scored parameters in physical and chemical processes; pests, invasive species, diseases and algal blooms), and the eight scored pressure parameters.

a) Condition of Biodiversity
The median score of all the scored biodiversity parameters across the SCS in Best10%, Most and Worst10% (of places/occurrences/populations) is shown in Figure 2. The confidence bar indicates the dataset average level of confidence (high, medium or low) applied by the experts to their individual estimates of the condition for each parameter.

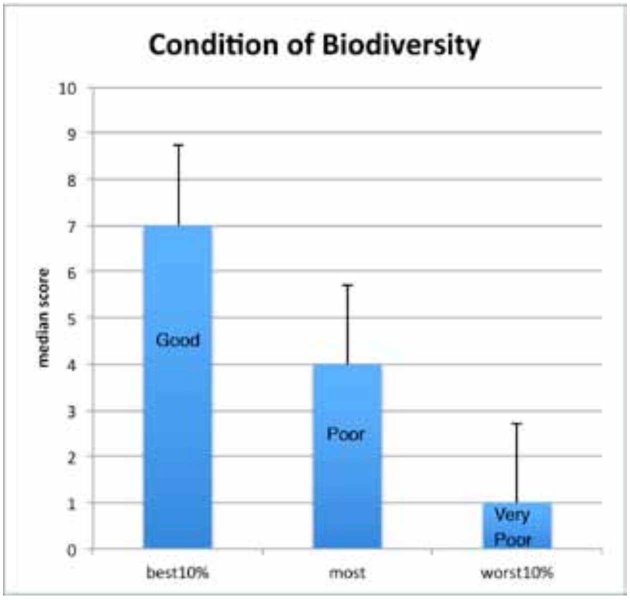


Figure 2. Median score and grade for the condition of all biodiversity parameters (habitats, species and species groups, ecological processes) in the Best10%, Most, and Worst10% places/occurrence in the South China Sea region. The uncertainty bar (derived across all the biodiversity parameters) represents an average level of confidence of 1.7 of a scoring unit.

The experts considered that the Best10% of the biodiversity of the region is in Good condition, and approaching the Very Good grade. However, for the Most category, representing a notional 80% of the biodiversity of the region, the condition was graded as Poor. The uncertainty bar (derived across all the biodiversity parameters) represents a level of confidence of 1.7 of a scoring unit, indicating that the experts considered that using this rapid assessment process, the status of biodiversity was, on average, assigned with a level of confidence between High and Medium.

b) Current Trends in Biodiversity Condition

The judgement of the experts is that Most biodiversity, the notional 80% of biodiversity across the SCS, is currently in decline (36 of the 56 parameters assessed in the Most category are in decline), with only a small proportion (four of the 56 parameters) improving in condition. Across all three of the data categories (condition scores of Best10%, Most and Worst10% places/occurrence) 45% of the parameter estimates indicated a decline. Overall, the judgement of the experts at this workshop was that biodiversity of the region is either stable or in decline, with very few parameters showing improving trends (Figure 3).

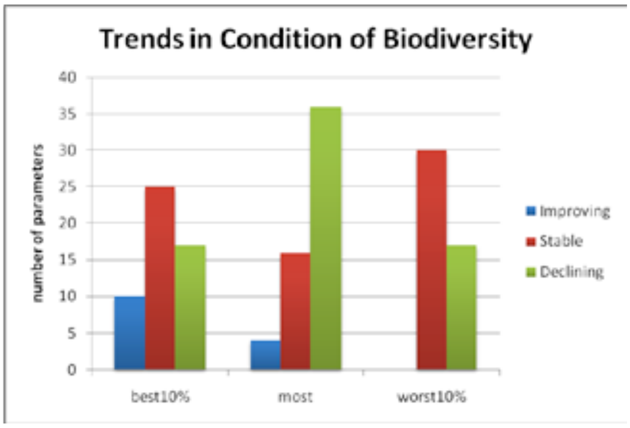


Figure 3. The estimated current (2007–2012) trend in biodiversity parameters across the SCS region, in each of the Best10%, Most and Worst10% places/occurrence.

The trends in condition for the majority of parameters (56%) were assigned with High confidence, and overall, the trends for 92% of the parameters were assigned with either High or Medium confidence (Figure 4).

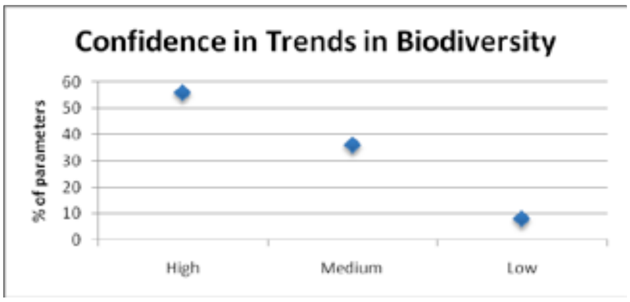


Figure 4. Confidence (High, Medium or Low) assigned by the experts to their assessments of trends in the condition of biodiversity shown in Figure 3.

c) Condition of Ecosystem Health

The median score across the SCS of all the scored ecosystem health parameters in Best10%, Most and Worst10% (of places/occurrences/populations) is shown in Figure 5. The confidence bar indicates the dataset average level of confidence (High, Medium or Low) applied by the experts to their individual estimates of the condition for each parameter.

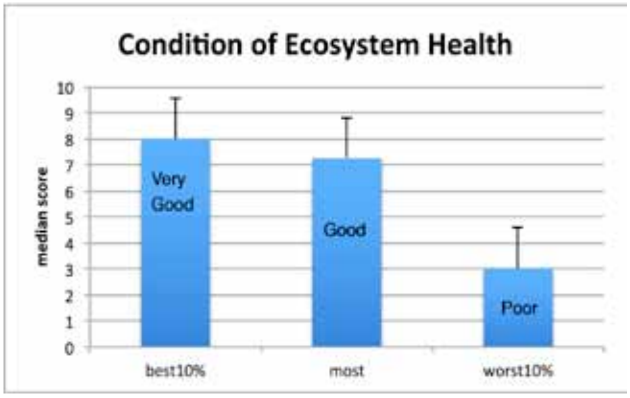


Figure 5. The estimated current (2007–2012) trend in biodiversity parameters across the SCS region, in each of the Best10%, Most and Worst10% places/occurrence.

The experts considered that the ecosystem health parameters in the Best10% of the region are in Very Good condition. However, for the Most category, representing a notional 80% of the ecosystem health parameters of the region, the condition was graded as Good. The uncertainty bar (derived across all the ecosystem health parameters) represents a level of confidence of 1.6 of a scoring unit, indicating that the experts considered that using this rapid assessment process, the status of the ecosystem health parameters were assigned with confidence that fell between High and Medium.

d) Current Trends in Ecosystem Health

The judgement of the experts is that almost all of ecosystem health parameters across the region are either stable or currently in decline (Figure 6).

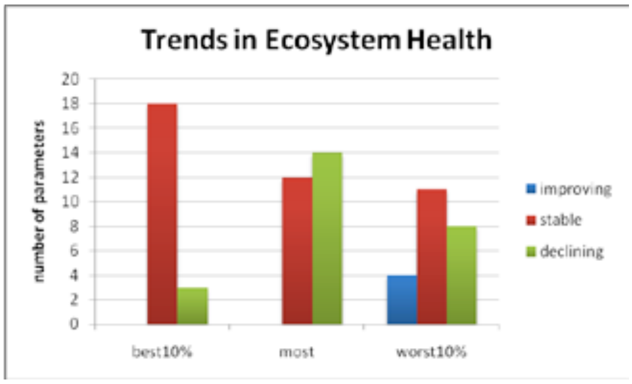


Figure 6. The estimated current (2007-2012) trend in ecosystem health parameters across the SCS region, in each of the Best10%, Most and Worst10% places/occurrence.

The trends in condition for the majority of parameters (72%) were assigned with High confidence, and overall, the trends for all of the parameters were assigned with either High or Medium confidence (Figure 7).

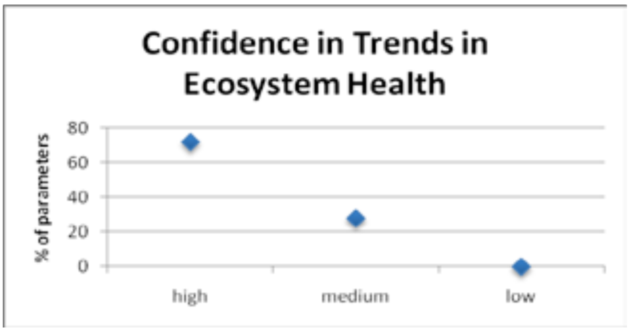


Figure 7. Confidence (High, Medium or Low) assigned by the experts to their assessments of trends in the condition of ecosystem health parameters shown in Figure 6.

e) Pressures

The combined impacts of the eight pressures scored in this exercise were assessed as resulting in Poor condition in Most places — the notional 80% of the area of the biodiversity and ecosystems of the SCS that were considered (Figure 8). Where the pressures have the least impact (the Best 10% of places), the impact is considered by the experts as consistent with the grading statement "few or negligible current impacts from this factor, and future impacts on the environmental values of the region are likely to be negligible" (this is the guidance provided in the Grading Statement for Very Good). Conversely, where the pressures scored here have the greatest impacts (Very Poor, in the Worst10%), the effects are considered by the experts as consistent with the grading statement *"The current and predicted environmental impacts of this factor are widespread, irreversibly affecting the values of the region, and there is serious environment degradation, or this is likely across the region within 10 years"*.

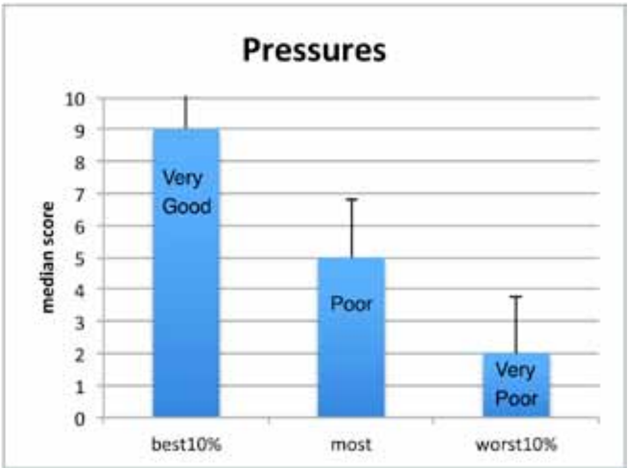


Figure 8. The impacts of human-induced pressures on the biodiversity and ecosystems of the SCS, scored as the condition in the biophysical environment as a result of the current and likely future effects of the pressures. The uncertainty bar (derived across all the scored pressure parameters) represents an average level of confidence of 1.8 of a scoring unit.

f) Trends in Pressures

The experts considered that the impacts from the pressures were either increasing or stable in all parameters in all three categories across the region. There were no pressures considered to be reducing to the extent that would result in an improvement in environmental conditions (Figure 9).

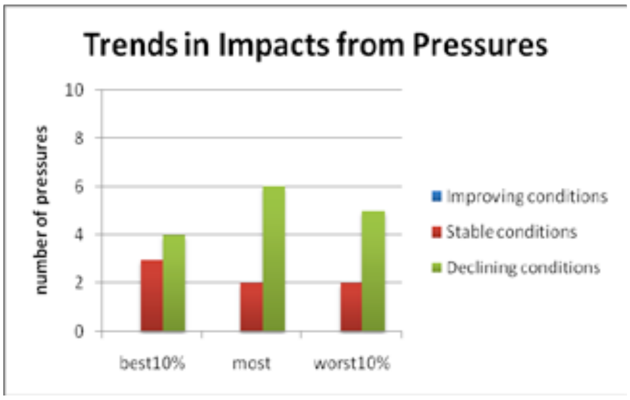


Figure 9. The estimated current (2007–2012) trend in impacts from pressure parameters across the SCS region, in each of the Best10%, Most and Worst10% places/occurrence.

The trends in pressures were assigned with either High or Medium confidence (Figure 10).

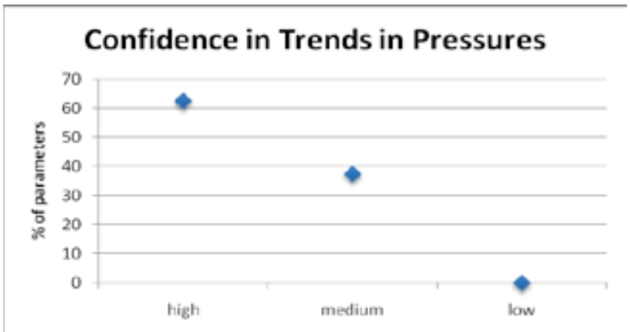


Figure 10. Confidence (High, Medium or Low) assigned by the experts to their assessments of trends in the condition of pressure parameters shown in Figure 9.

Regional Overview of Condition: An Integrated Assessment

Data contributed by experts through this methodology, such as that summarised above, may be used at the regional scale for a number of purposes. For the purpose of a regional overview of the marine environment, the data from the workshop are used here to explore patterns in the condition of the biodiversity, the pressures that impact it, and the quality of the available data/information. Further examples of possible uses of the data are outlined in Annex 4, including for more specific prioritisation purposes.

This integrated overview of the environment of the SCS uses all the expert-derived data on biodiversity and ecosystem conditions, the pressures impacting on those conditions, the trends in changes currently observable in the region, and the quality of the available information base. The integration of these differing types of information within a single analytical framework provides a mechanism for assessing patterns amongst these various information types across the whole region, and enables a broad overview of the issues to be quickly established. Such an overview may be of value for policy-makers to identify parameters (and ultimately the places) where various forms of intervention may need to be delivered, and may assist agencies and governments in the setting of region-wide marine environment investment priorities.

The parameters scored at this workshop cover four key areas that can provide an overview of the marine environment of the SCS:

1. Identity of the important biodiversity and ecosystem components of the SCS, and the pressures acting on those components;
2. Current condition of these components and pressures relative to a reference point that represents conditions at a time of higher system quality and resilience;
3. Current (5-yr) trajectories of change of these components;
4. An estimate of the confidence assigned by experts attending the workshop to the information base used in this workshop (this combines three aspects of knowledge limitations: suitable scale/focus of knowledge about a parameter doesn't exist; an appropriate information base does exist but has not been synthesised or made available to the workshop; and, the limitations in the personal knowledge of the experts attending the workshop).

These four types of information enable an integrated set of outputs that can identify, at a system-wide level, a range of types of environmental issues. For example, it may identify the high value ecosystems and species that are also under high levels of pressure, and are rapidly changing, but have low information quality; or any combination of these matters. The combination of these four types of issues may also relate to important cultural, social, or economic consequences that are not revealed in more usual assessments based on, say, just an analysis of pressures or condition alone.

The integrated analysis demonstrated here uses an un-weighted multivariate analysis of pattern in the data that was provided by the experts at the workshop. This data has a number of limitations—most likely additional experts would be required for a fully comprehensive coverage of all the important environmental components of the SCS region, but even so, for many important aspects of the region, the experts at the workshop had high confidence in their scoring/grading. A more comprehensive integrated analysis might choose to sieve the information by using only high and medium-confidence data, since workshops like the one conducted here always will have issues with the extent of availability of experts. However, leaving out parameters that are assessed with low confidence introduces a further bias to the outcome—assignment of low confidence at the workshop does not mean that the scores/grades are not accurate, and removal of these parameters from the analysis skews the outcomes mainly towards parameters for which there is full knowledge, much of which will have been obtained because it relates to a well known issue. Here, the full data set has been retained for the purposes of this example. A more comprehensive assessment would test the sensitivity of the outcomes to the inclusion of low and medium confidence data.

The multivariate analysis uses the information content of the data, but makes no assumptions about underlying statistical distributions, and uses only a simple set of well-tested non-parametric statistical tools, available free (or at low cost) in the public domain. The approach used here is cluster analysis, which classifies the parameters into coherent groups of parameters with similar information content across all eight of the indicators scored/graded for each parameter.

The information pattern for the data provided by the experts for the 104 parameters that were scored at the workshop is shown in the classification dendrogram (Figure 11). The eight groups of parameters shown in the dendrogram each have unique patterns in condition, trends, confidence and information base, and some examples are discussed below.

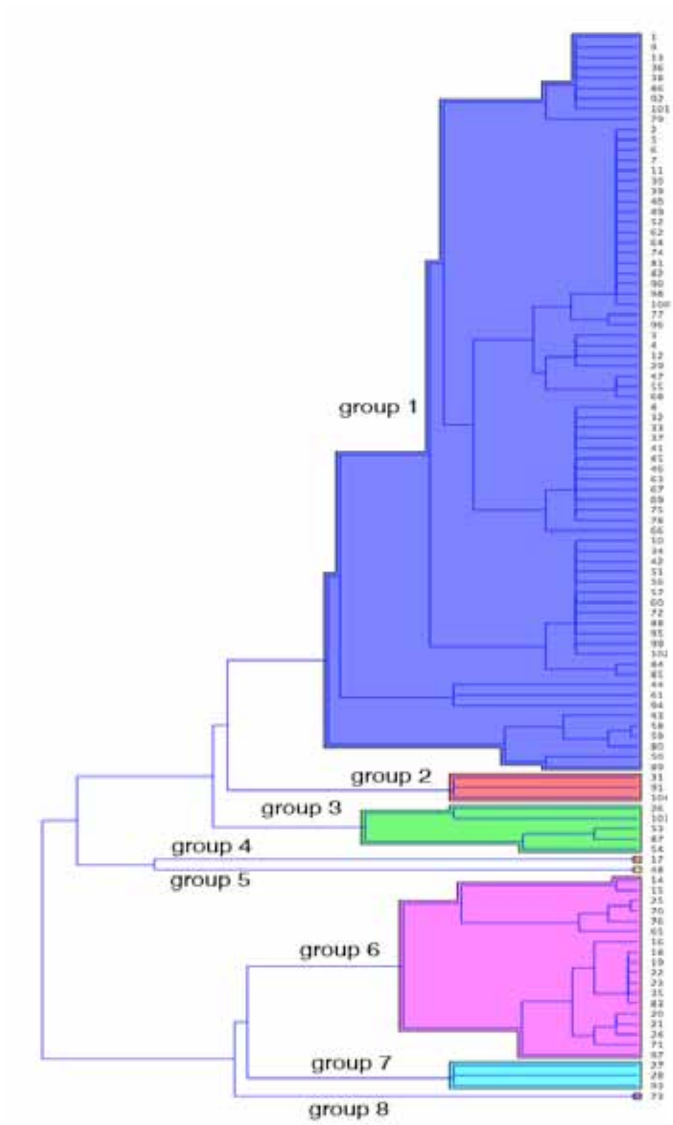


Figure 11. Classification (average linkage) of scores assigned at the workshop, resolving the 104 parameters into 8 groups of parameters that share similar characteristics as defined by the scores/grades.

The important point about the cluster analysis is that the differences being displayed are the summarised differences relative to the differences between all the other parameters. This helps to avoid what might be a small relative difference for a small number of parameters being prioritised as important, when there are other parameters that may be also as (or more) important but not recognised as such because they are measured or reported using different indicators or in a different way.

To guide assessment, the cluster analysis is further summarised in a 'heat map' diagram. This graphic (Figure 12) depicts the extent to which the groups in the cluster dendrogram are different from each other. The higher differences identify greater relative divergence in the patterns of information, and indicate which groups may be worthy of more detailed discussion or investigation. The highest differences in the heat map are linked to Groups 6, 7 and 8 of the cluster.

Classification Groups 6, 7 and 8 consist of 22 parameters: 14 species groups, five physical or chemical processes, and one each of habitat; pests, diseases; and pressure parameters (Table 1). These parameters have high average levels of condition (Figure 13), and most of the parameters in Most and Best10% places are either stable or increasing (Figure 15), assigned with medium to high confidence (Figures 14, 16).

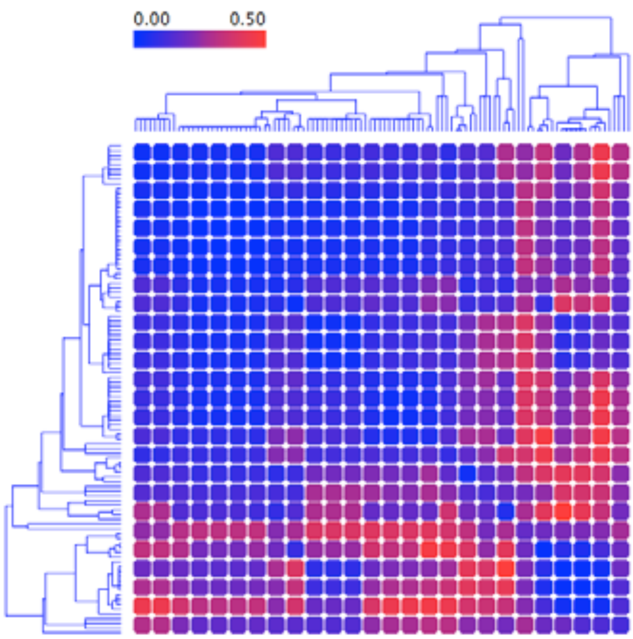


Figure 12. Heat map symmetrical matrix of groups from the classification (Figure 11); the dark blue cells represent lowest difference in information content, red cells represent the highest level of difference in information content. The greatest differences are demonstrated by groups 6, 7 and 8.

In Groups 1 to 3, the average score for all parameters in the Worst10% areas of the region is Very Poor, and a substantial proportion of these parameters continue to decline across the region.

In Group 6, 15 of the 16 parameters are distinguished in the cluster analysis because they were not assigned scores/grades for either condition or trends in Best10% or Worst10% of places. A large proportion of these parameters were species groups of fish where there was general knowledge of their overall conditions and trends, but no specific knowledge finer than regional scale. The lack of region-wide spatial knowledge about these populations might be an

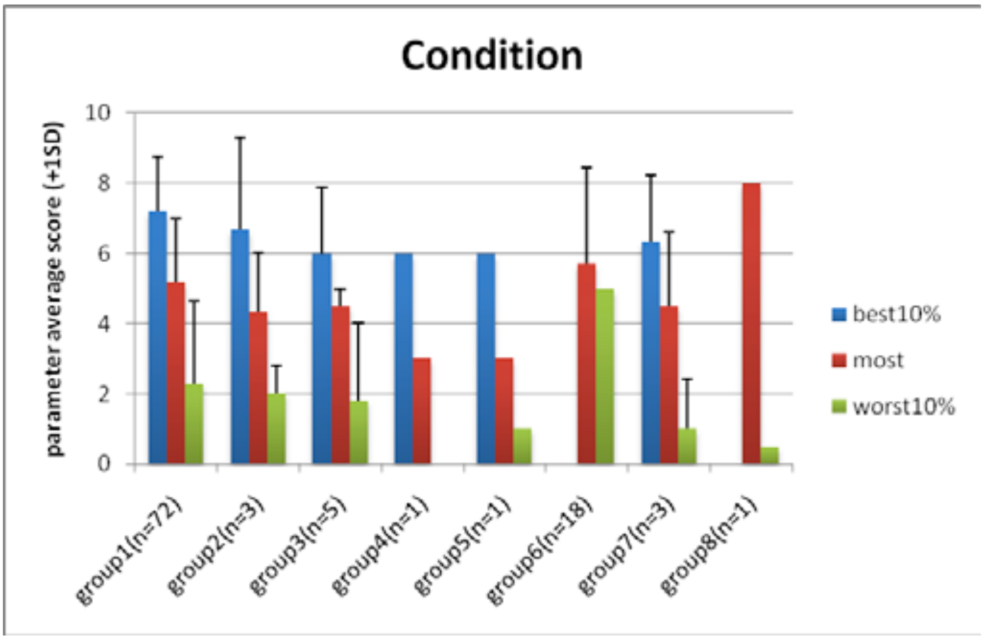


Figure 13. Average condition scores for the region for each of the 8 groups from the classification shown in Figure 11, with 1 standard deviation bar, for the Best10%, Most and Worst10% areas. (n = the number of parameters included in a group).

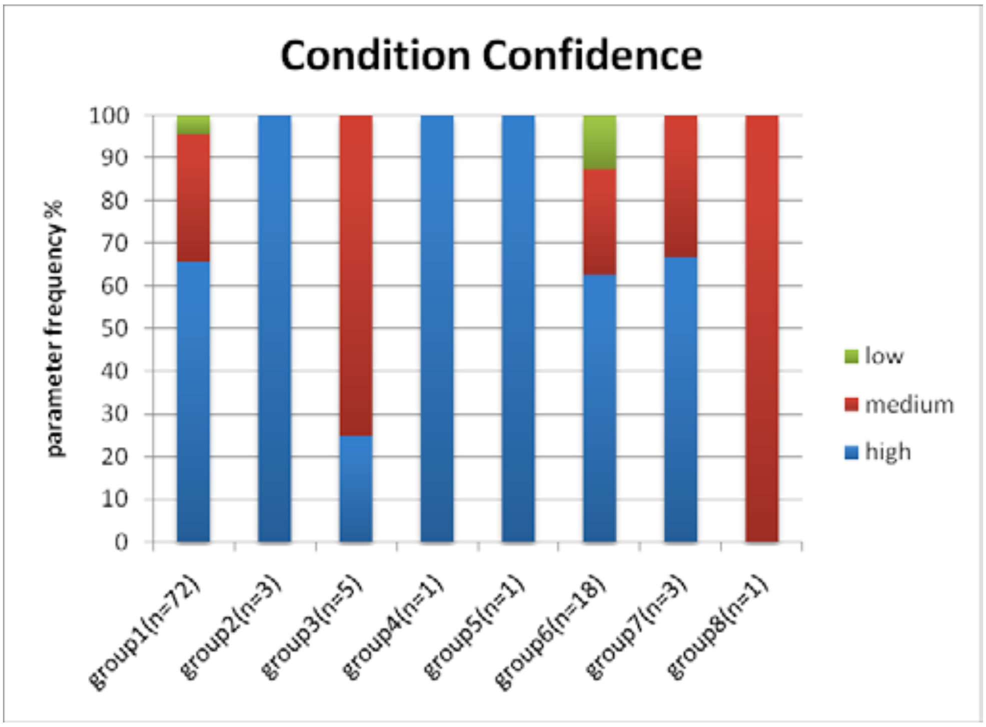


Figure 14. Summary of the confidence levels assigned by the experts to each group of parameters identified by the classification: frequency of parameters (%) assigned High, Medium or Low confidence for each classification group. (n = the number of parameters included in a group).

important outcome from this workshop, and provide guidance for prioritising further information capture programmes in the region.

The parameters in Group 7 have a substantial range between the Best10% and Worst10% of places, assigned with a Medium to High confidence, and all the parameters in this group show continuing decline across most of the region (Table 2). Other members of Groups 6, 7 and 8 also demonstrate continuing regional decline, such as dugongs, which were assessed as in Very Poor condition and continuing to decline across the region.

Further examples of possible questions that can be asked of the workshop data and accompanying frameworks for integrated analysis are shown in Annex 4.

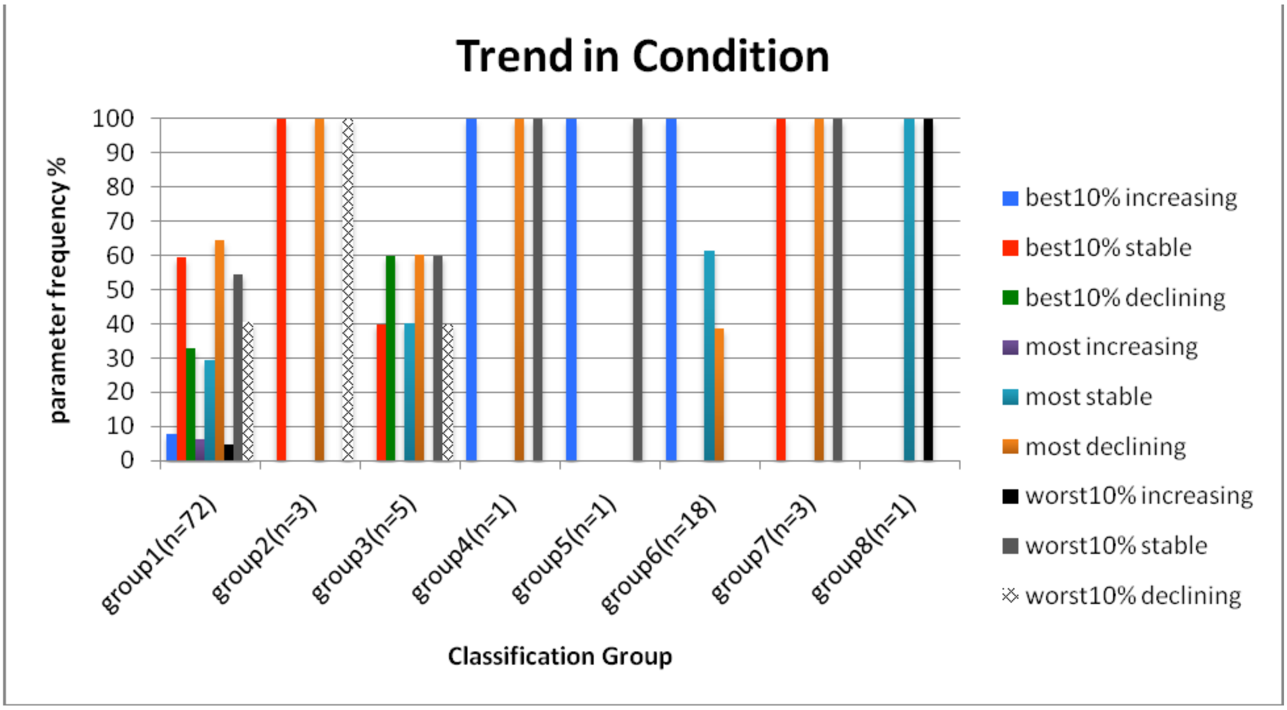


Figure 15. Summary of the trends assigned by the experts to condition parameters within each of the classification groups: frequency % of parameters Increasing, Stable or Decreasing in condition, within each of the Best10%, Most and Worst10% areas of the region.

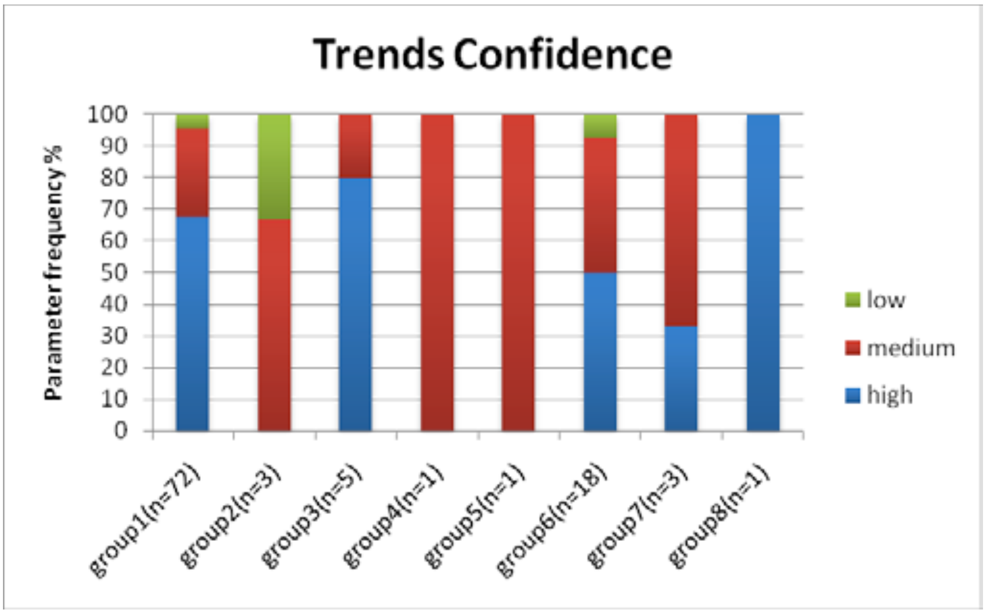


Figure 16. Confidence levels assigned by the experts to the trends in the condition of parameters, summarised by classification groups: frequency % of parameters assigned with High, Medium or Low confidence.

#	Parameter	Biodiversity Component	Score (most)	Confidence
14	whales - baleen	Species groups	8	Medium
15	whales - toothed	Species groups	8	Medium
16	dolphins, porpoises	Species groups	6	Medium
18	dugongs	Species groups	1	High
19	sharks and rays	Species groups	2	High
20	whale shark	Species groups	4.5	Low
21	tuna and tuna-like fish	Species groups	3	High
22	inner shelf (0-50m) demersal large fish assemblages	Species groups	2	High
23	inner shelf (0-50m) demersal small fish assemblages	Species groups	3.5	High
24	outer shelf (50-200m) demersal & benthopelagic fish assemblages	Species groups	3	Medium
25	meso-pelagic fish assemblages	Species groups	6	Low
27	inner-shelf reef fish assemblages (0-50m)	Species groups	3	High
28	grazers/herbivorous fish assemblages of coral reefs	Species groups	3	High
35	seabirds - resident	Species groups	8	High
65	Ha Long Bay WH	Habitats	7	–
70	ocean currents, structure and dynamics	Physical, chemical processes	9.9	High
71	storms, cyclones, wind patterns	Physical, chemical processes	9	–
73	sediment transportation	Physical, chemical processes	8	Medium
76	sea temperature, including SST	Physical, chemical processes	8	Low
83	ocean salinity	Physical, chemical processes	9	High
93	frequency, abundance distribution of algal blooms	Pests, diseases, etc	7.5	Medium
97	climate change and variability	Pressure	5	–

Table 1. Parameter membership of classification Groups 6, 7 and 8. Average condition (Most) = Good (score 5.7).

#	Parameter	Condition			Confidence	Condition			Confidence
		Best 10%	Most	Worst 10%		Best 10%	Most	Worst 10%	
27	Inner-shelf reef fish assemblages (0–50m)	5	5	5	H	5	5	5	H
28	grazers/herbivorous fish assemblages of coral reefs	5	5	5	H	5	5	5	H
93	Frequency, abundance distribution of algal blooms	9	9	9	M	9	9	9	M

Table 2. Parameter membership of classification Group 7, showing raw data captured at the workshop.

Spatial Resolution: This workshop did not involve spatial resolution below the level of region (the SCS was addressed as a single unit), other than any inherent spatial resolution inferred by the parameter itself (e.g. seagrass beds are restricted to shallow waters, and cannot occur in waters deeper than 50 m in this region, so any assessment of relative condition is based on the distribution of the area of shallow waters across the region). This also means that, before any actual commitment of resources or action informed by the outputs of this or similar workshops are carried out, both the accuracy of the experts' judgement and the spatial distribution of the parameters being addressed would need to be further resolved and verified. In further workshops, particularly those at the national level, finer-scale spatial resolution of the input data would yield a higher level of output spatial resolution, and for some parameters this could reduce the need for extensive further verification to underpin policy development.

Economic, Social and Cultural aspects: This workshop did not specifically address the economic, social or cultural aspects of the region in relation to the environmental issues. The primary reason for this was that a different set of experts would be required in order to make judgements about the magnitude and importance of the consequences of the environmental issues. Nonetheless, if such experts were available to contribute relevant data and information, the methodology would have been capable of resolving the issues and grouping environmental drivers and economic etc. consequences together at the region-wide scale, in a manner similar to that discussed above, for the environmental features of the region.

The methodology and approach trialled at this workshop, while broad in scale and strategic in content, provides for a semi-objective mechanism for integrated assessment. At best, it may be able to deliver prioritised sets of environmental factors that relate well to economic, social and cultural issues and the consequences of ocean degradation. At worst, it may be used as a strategic mechanism to focus attention on a small subset of issues for more detailed later evaluation, including better spatial resolution, leading eventually to corrective action. Irrespective, the process of bringing together experts to address the issues within a common currency framework of expert judgement increases the likelihood of establishing a common understanding across jurisdictions, across disciplines and across the science-policy divide that plagues integrated management of the world's oceans.

Amendments to the Methodology

Adopted Amendments

Throughout the workshop, a number of suggestions were made by experts about improving the focus and effectiveness of the overall methodology, and sharpening the approach to be more functional in the specific regional context of the South China Sea. Changes adopted included:

Condition: The workshop did not have any available time to consider both Large Marine Ecosystems (LME) – SCS and the Gulf of Thailand – as was originally proposed. The scoring and grading system was therefore constrained specifically to the boundaries of the SCS LME. The matrices and summary outcomes reported here only refer to the defined area of the SCS LME.

Pressures: it was agreed that the social and economic implications of the pressures on the environmental and biodiversity values of the SCS would not be scored, because of a lack of appropriate expertise available at the workshop, and difficulty in understanding the application of three spatially-based indicators (Best10%, Most, Worst10%) to these pressures. Instead, a short list of selected examples of the likely social and economic impacts created by the effects of the pressures on the ecosystems and biodiversity was recorded into the scoring matrix, in association with the relevant pressure.

Suggested Amendments

Several other changes were suggested for adoption, although they could not be applied because there was either a lack of agreement amongst the experts, or they could not be applied in mid-workshop because of the significant investment in the existing methodology activity up to that point. Each of the suggestions not adopted were carefully considered by the workshop organisers, and while some of the variations could have value at the national level of assessment, they were ultimately not considered to be likely to improve the assessment outcome of either this workshop or a full regional integrated assessment approach.

Description of the Workshop

At the end of the workshop, participants were offered the opportunity to provide commentary and feedback on any aspect of the workshop. The comments from individual participants were captured in real-time visible to the participants, and are summarised below, with, where appropriate, comments (post-workshop) in reply by the Moderator.

Comments made by participants on the overall value of this workshop to South China Sea region

- Most of the participants are now familiar with method

- Participants improved the methodology in some important aspects

- It is difficult to come up with assessment on this scale – there is a disconnect with local level. Better data, images, maps, ports distribution etc would have been a big help, so there is a need for additional resource material to be available prior to the workshop.
  Moderator: *participants were advised to bring with them any data and information that might be relevant to the issues; now that participants understand the scale and detail of information for this type of assessment, then this request may be clearer for future workshops of this type.*

- The large area of the SCS was difficult to cover. These three days represent an initial step in assessment of SCS. There are many issues that need to be considered. After three days there is only a weak scientific basis. After group discussion some criteria are considered to be weak, although this can be changed based on individual views. There is still confusion. The assessment wasn't correct for inclusion in the WOA because it lacks accuracy. Information from countries is needed for initial information for each working group to consider. Need a lot of consultation amongst countries after this meeting to determine if this methodology can be used.
  Moderator: *participants were guided through the rapid assessment methodology – while it is their scientific opinion that was being sought, no assessment of this scale could achieve the level of scientific robustness that was requested by some participants. The methodology is a process to rapidly harvest opinion, not investigate the detail of the science, and is matched to the type and detail of information generally required by decision-makers within a typical national or regional policy setting framework.*

- It is hard work to come up with an integrated assessment even at the regional level. An assessment at the global level will be even harder!

- It is recommended that before such a workshop the participants should do their homework. Get familiar with the area before the workshop, and get early access to data.

- Methodology – too many parameters – perhaps select some indicators for this region.
  Moderator: *selecting indicators for which there is a strong set of data is fatal to expert elicitation procedures in this form of decision model, which is explicitly designed to operate in a mixture of data-rich and data-poor situations – if this suggestion were to be followed, there is no need for this form of workshop or methodology. Participants were invited to comment on the full set of parameters and indicators prior to the workshop, and although few chose to engage in that opportunity, a number did engage in the detail, and the list of parameters assessed at the workshop can be reasonably assumed to cover a substantive proportion of the biodiversity and ecosystem health assets and values of the SCS.*

- Methodology is interesting approach. Perhaps could be conducted at a smaller scale in the countries first; this could be better and then combine to make a regional assessment. Parameters—some are not applicable, so a revision is needed.

- Key species driving ecosystem change are different in SCS than in Australia. Participants need basic data before the workshop, and the secretariat needs to list important databases for this analysis. Needs to be chemical, biological etc. NOWPAP region consists of four countries – could use this methodology in that region where data are scarce.
  Moderator: *the methodology is based on key*

attributes of marine ecosystems worldwide, not just in SCS or Australia. The attributes do not all occur in SCS, so these would not have been scored, but the ones that do occur were to be scored. Additional features of the SCS that are unique are freely added to the generic parameters, at participants' suggestion.

- Assessment results for the SCS are positive. However, this is an informal assessment—just a trial. There are not enough experts here to cover all parameters. Some parameters have no data support. Not enough time for discussion, therefore decide that result is informal. Methodology needs to be more reliable – better to have more defined definition for parameters. For example, what is a coral reef in each part of the assessment, so need definition? Structure is fine – ecosystem first, then examination of pressure which is good, but need to refine to optimize the structure and avoid duplication. This would make it simpler.

- Expert system is very useful. Concern when talking about conditions and trends, this works, but threats and pressures perhaps do not depend on size. Threats and pressures should be included in relation to MPAs. Score should be recorded in different subgroups for statistical comparison, or score rules should be harmonized. But expert system useful and big future for complicated areas to give a very fast assessment.

  Moderator: *the scoring procedures are firmly established, but perhaps they needed better explanation at the beginning of the workshop, in more extensively worked examples.*

- More rigour needed in the data, need some real data, especially if we are going to identify worst places. This would provide confidence.

- Structure of indicators needs to be more linked to the outline of the WOA. To use for WOA needs to be closer linked. To invite scientists must be done on personal capacity not on behalf of countries—otherwise this will bias the result. Regional scientists that know the region provide better input to process. Good preparation on the disciplines, need to have a list of skills so we know we have coverage of all the issues. Pre-workshop discussions useful but cost involved. Need to remove Australian language and make sure terms are put into international language. Agree that on one side need access to better data, or ability to get data during the workshop (but scientists always say they need more data) but this process is based on intuitive and expert opinion. Way the workshop is run and how opinion is elicited is important.

Group feedback on potential application of this workshop methodology to marine assessments in individual countries

- This is a Capacity Building workshop, so the assessment output is not the main thing, but how much the participants learned from the process. This process not new because many participants were involved in GIWA. This is useful in countries but need to spend more time on methodology before attending a workshop. A difference in approach to the methodology was evident in parts of scoring by one subgroup, so need to spend time agreeing on methodology and getting a common understanding. Some recommendations have been made, but not sure if they are correct.

- Useful. In terms of applying in country, perhaps better access to better range of experts. Might be best applied at a country level, as opposed to region where there are different issues and availability of expert opinion.

- Applicable at the national level. Good indication of state of the marine environment. Doubts about application to regional level. WOA has been asked to use existing assessments, and several already exist in the region.

  Moderator: *the issue about using existing assessments is usually that they typically focus on different problems, use reporting systems that are largely incompatible with each other, and the integration of information becomes very subjective. The methodology used in this workshop makes the subjective decisions explicit, and at a low level in the decision hierarchy, assisting to overcome bias that may be otherwise hidden in the outcomes. The data and information from the existing assessments can easily be used as input to a regional assessment based on the methodology used in this workshop. This methodology can be considered as a key part of the integrating mechanisms for a wide variety of other types and levels of data and information.*

- Useful, especially to compare to the "Coral Triangle" report. Need link between analytical situation and actionable opportunities – another workshop is needed. Might need to segmentise some of the scales – put into context from area and impact level. Perception vs overall impact on a regional scale.

  Moderator: *this is also an issue about accuracy: whereas the perceptions can be assessed for precision, where a specific investment action is planned to be undertaken as a result of prioritisation from expert opinion, it is always nec-*

essary to validate the accuracy through either more detailed analysis of the underlying data and information, and possibly through targeted additional research.

- Methodology applicable to state. If experts agree well and know environment well. This can be considered to be a social science because based on judgment – but not scientific assessment because the initial data are not scientific facts but the opinion of each expert. Suggestion for improvement – when the scores are given – we do not know the difference in levels of the scale, so too broad definition of the scale. No statistical analysis result – so result needs to be displayed based on statistics (even social science).

  Moderator: *while this methodology is based on judgements, the data are the judgement of scientists with experience in the area. The question of what is a fact is complex; in environmental assessments the main issue usually revolves around the choice of questions being asked by the science — when science provides an answer that might be considered factual, is it an answer that can be actually used for well grounded region-scale policy making?*

- Concerned how to explain this to an expert meeting back home, how to explain what we did. People will ask, some confusion in this workshop especially today, but need to be able to inform. No confidence to explain the methodology. Show results and parameters – experts may say how did you give these scores? We gave a score relying on experts to fill the scores. Maybe hard to get co-operation from experts, so need more detailed guidelines and explanation of parameters. More detailed information would improve process and perhaps proceed.

Discussion on potential application of this workshop methodology to the World Ocean Assessment

- Need to nominate experts to the pool of experts for the first WOA. See the DOALOS website for details.

- AOA-2007–09, Group of Experts looked at assessments to find best practice. Results endorsed by the UN General Assembly. Any WOA – relevant, legitimate (involve real experts and good communication between all players; via website, meetings like this, more formal workshops such as that at Sanya) and credible (good evidence for what we say, this work here valuable for identifying material we need to look at). Less valuable – we need to have a clearer way to link judgment to the underlying evidence. We can use the judgment here, but need more formal way of linking the conclusions – signposts to credibility. The result here necessary but not sufficient to achieve credibility. This process most interesting in regards to the overall assessment – environment, society and economy. Need to bring together different elements and this process will provide an interesting way on how this can be done. Process has produced interesting ideas on how the socio-economic aspects can be looked at but needs more focus to link these. This is the first time we have looked at socio-economic aspects. Whether appropriate for other regions needs discussion, but helpful in introduction to SCS.

  Moderator: *normally these workshops are run with specific datasets and information bases agreed/provided, across all relevant parameters. Where there is no such data, then the workshop judgement is no less relevant, since there will be no better judgements able to be made, assuming that the relevant experts are assembled for the workshop. This applies equally to biophysical and socio-economic aspects.*

- When doing assessment assume that the result will need to be reinforced in management process, so need to be very objective, so needs to be based on quantitative data not qualitative data. Need to keep in mind IPCC 4th report which pushes countries to reduce emissions – this affects countries. WOA may act like that in the future so we need to be very cautious because this can have influence.

- Data – all the countries should go away and come back with a metadata base for their countries.

- SCS data poor situations, management needed in data poor situations also, so there is a need for data but we need to educate decision-makers to accept a score that is the best guess of a well-informed group of scientists. The score is then also quantitative data. Needs to be linked to governance: international waters programmes learned that assessment and governance are separated but need to be combined.

- UN General Assembly advised governments to build on existing regional assessments.

  Moderator: *this workshop has used the outputs of from a variety of existing assessments, and although more could have been used if it were available, the framework and methodology used here is fully consistent with the UN GA guidance.*

Conclusions and Recommendations

These conclusion and recommendations arose from the process of the workshop, and from the comments and feedback above.

National Level Assessment: the methodology has promise to be conducted at a national level in various countries of the SCS region, and this was raised by participants on a number of occasions, with a view towards making a contribution to the WOA integration process. Where national jurisdictions decide to conduct this form of rapid assessment to inform their contribution to the WOA, in conducting this form of assessment at the national level, their process should follow the sequence of these seven steps to enhance feasibility and accuracy:

1. Identify/agree on the boundaries of the spatial area to be assessed, and any spatial subsets, subregions etc; this may involve a purely national jurisdiction, or could combine with adjacent jurisdictions where there are contiguous assets and values, such as for example, major contiguous habitat types that span national boundaries.

2. Develop an agreed list of parameters to be assessed through a workshop and discussion with experts who will attend the Assessment Workshop, and agree on the guiding statements and rules governing the conduct of the workshop. These parameters should be comprehensive and represent important aspects of the region, and not be limited in the first instance to those with available data (this would otherwise create a major bias, as discussed in the report above). This is an important step, and should be the focus of an Initialisation Workshop, where the relevant experts are exposed to the methodology (perhaps in a trial, or a mini-version of the Bangkok workshop), and are thereby charged with the responsibility to subsequently provide a list of the fundamental components and parameters for the area under assessment as agreed in step 1 above.

3. Require experts to (remotely) fill in matrices with their scores for each parameter within their competence, with remote guidance by a moderator. Then collate all scores, and provided the completed matrices with aggregated scores/grades to workshop attendees prior to the Assessment Workshop.

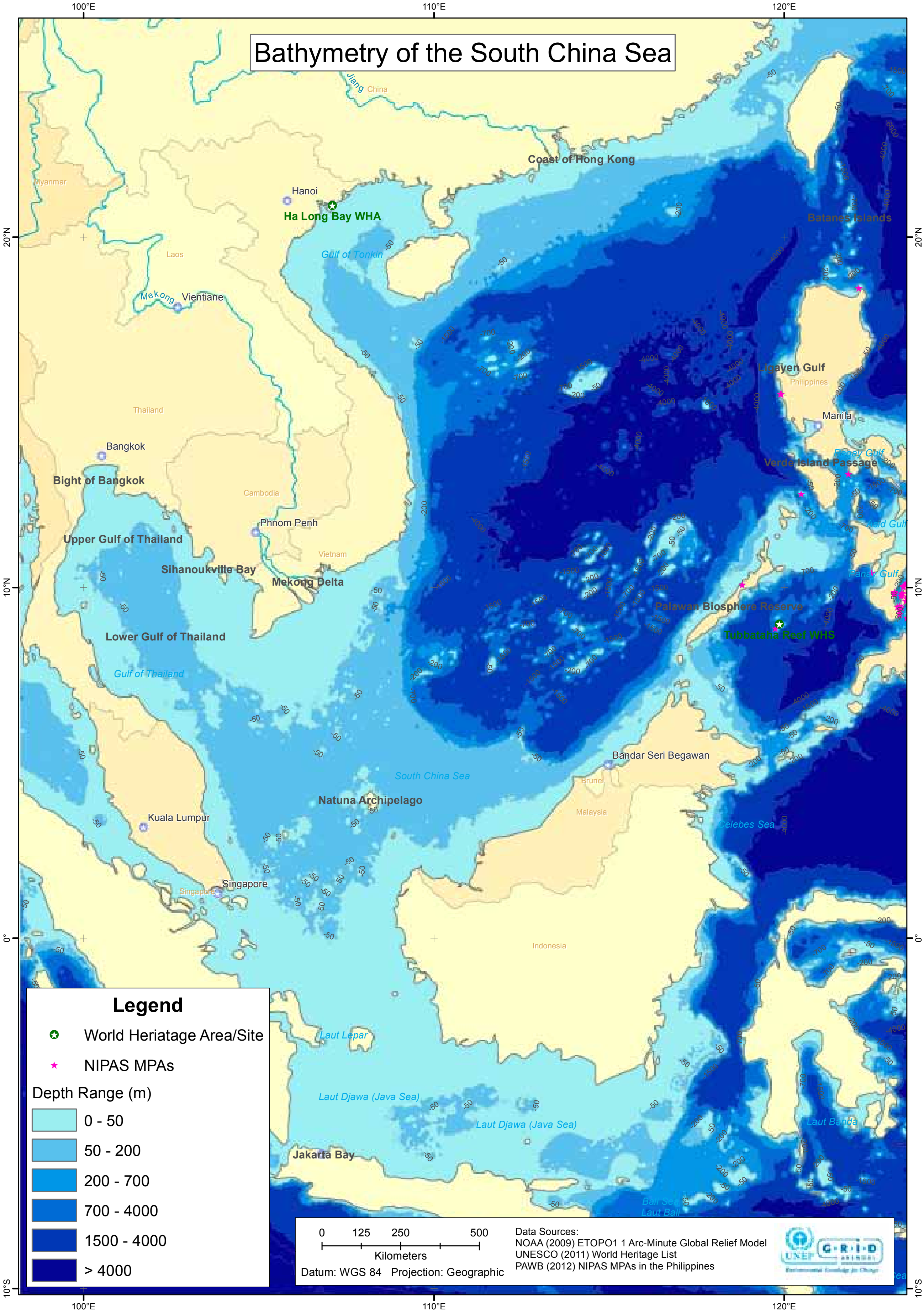
4. Conduct the Assessment Workshop, using the same approach as the Bangkok Workshop, using the initial scores of the experts as the starting position for sub-group discussions/refinement.

5. Compile a final draft set of matrices and conduct a rapid statistical summary analysis for post-workshop circulation and verification.

6. Compile a second round set of refined matrices and scores by correspondence, and circulate for final revision.

7. Conduct detailed statistical analysis and issue a draft report, and conduct an Outcomes Workshop, where the experts re-convene and consider the details of the assessment findings. This would give experts a final opportunity to consider outcomes, and to make a defence in front of their peers of any contested findings, should that be needed. Also, the implications of the assessment could be discussed in terms of guidance for regional organisations and input to the WOA.

At several stages of these steps above, there will need to be collation of data and provision to experts of the established data and information, so that judgements are better supported, and explicitly linked to, an anchor information base. The conduct of such a national (or sub-regional) assessment should probably be expected to span about 18 months, giving adequate time for the number of iterative steps described above, including assembly of relevant reports and databases etc, some of which may need to be synthesised for the specific purpose of the assessment process (including such aspects as spatial modelling or aggregation). The important attribute of this stepwise approach discussed above is that because participants know how the data will be aggregated and presented within the methodology, the extent of detail required in the input data is clear, and effort required to prepare synthesised or modelled data can be matched to the expected level of use within the methodology. This increases the feasibility of achieving a more comprehensive assessment, and improves the likely accuracy of the outcomes.



Bathymetry of the South China Sea
Coast of Hong Kong
Hanoi
Ha Long Bay WHA
Gulf of Tonkin
Vientiane
Bangkok
Bight of Bangkok
Upper Gulf of Thailand
Phnom Penh
Sihanoukville Bay
Mekong Delta
Lower Gulf of Thailand
Gulf of Thailand
Lingayen Gulf
Manila
Verde Island Passage
Palawan Biosphere Reserve
Tubbataha Reef WHS
Bandar Seri Begawan
South China Sea
Natuna Archipelago
Kuala Lumpur
Singapore
Celebes Sea
Laut Lepar
Laut Djawa (Java Sea)
Jakarta Bay
Laut Banda
Legend
World Heriatage Area/Site
NIPAS MPAs
Depth Range (m)
0 - 50
50 - 200
200 - 700
700 - 4000
1500 - 4000
> 4000
0 125 250 500
Kilometers
Datum: WGS 84 Projection: Geographic
Data Sources:
NOAA (2009) ETOPO1 1 Arc-Minute Global Relief Model
UNESCO (2011) World Heritage List
PAWB (2012) NIPAS MPAs in the Philippines
100°E
110°E
120°E
20°N
10°N
0°
10°S

Annexes

Annex 1: List of participants

CAMBODIA

Mr. Koch Savath
Deputy Director General
Ministry of Environment.
#48 Samdech Preah Sihanouk
Chamkarmorn, Tonle Basak
Phnom Penh, Cambodia
Tel: +855 12 787 088
Fax:: +855 23 213 900/ 215 925
Email: kochsavath@gmail.com

Mr. Hak Mao
Head of Climate Change Vulnerability
Assessment and Adaptation Office
Ministry of Environment
#48, Samdech Preah Sihanouk
Chamkarmorn, Tonle Basak
Phnom Penh, Cambodia
Tel: +855 16 889 634
Fax: +855 23 219 287
Email: cheamao2003@yahoo.com, maohakccd.se@gmail.com

CHINA

Prof. Guo Zhenren
Head
Marine Environmental Research
Center, South China Institute of
Environmental Sciences (SCIES)
Ministry of Environmental Protection
of the People's Republic of China
7 West Street, Yuancun
Guangzhou, P R China
Tel: +86 20 855 36352
Fax: +86 20 855 36352
Email: guozhenren@scies.org

Dr. Yu Xijun
Senior Engineer
South China Institute of
Environmental Sciences (SCIES)
Ministry of Environmental Protection
of the People's Republic of China
7th West Street, Yuancun
Guangzhou, P.R. China
Tel: +86 20 85528748
Email: yuxijun@scies.org

Dr. Hao Chen
Associate Professor
Room 235 Building 2
Chinses Research Academy of
Environment Sicences
#8 Anwan Dayangfang Chaoyang
District
Beijing 100012, P.R.China
Tel: +8610 84913914
Email: Chenhao@craes.org.cn

Mr. Jianbo Han
Deputy Chief
Marine Chemistry Division
National Marine Environment
Monitoring Centre
State Oceanic Administration
42 Linghe Street, Dalian, P.R.China
Tel: +86 411 8478 2515
Fax +86 411 8478 3277
Email: jbhan@nmemc.gov.cn

Ms. Xinzhen Lin
Chief, International Cooperation Office
National Marine Environmental Monitoring Centre
State Oceanic Administration
42 Linghe St
Dalian 116023, P.R.China
Tel: +86 411 8478 3299
Fax: +86 411 8478 3277
Email: xzlin@nmemc.gov.cn

Ms. Juying Wang
Member of Group of Experts, Regular
Process & Chairperson of WESTPAC
Working Group on GRAME
Chief, Marine Chemistry Division
National Marine Environment Monitoring Centre
State Oceanic Administration
42 Linghe Street
Dalian 116023, P.R. China
Tel: +86 411 8478 2526
Fax: +86 411 8478 3277
Email: jywang@nmemc.gov.cn

INDONESIA

Prof. Indra Jaya
Dean, Faculty of Fisheries & Marine
Sciences
Gedung FPIK, Kampus IPB Darmaga
Bogor 16680, Indonesia.
Mobile: +62811892394
Fax: +622518622909
Email: indrajaya@ipb.ac.id, indrajaya123@gmail.com

JAPAN

Dr. Yasuwo Fukuyo
Professor, Director
Asian Natural Environmental Science
Center
University of Tokyo
Tel: +813 5841 2782
Fax: +813 5841 8040
Email: ufukuyo@mail.ecc.u- tokyo.ac.jp

Dr. Takeshi Kawano
Program Director
Ocean Climate Change Research Program
Research Institute for Global Change
Japan Agency for Marine-earth Science
and Technology (JAMSTEC)
2-15, Natsushima
Yokosuka 237-0061, Japan
Tel: +81 468 67 9471
Fax: +81 468 67 9455
Email: kawanot@jamstec.go.jp

Dr. Kentaro Ando
Team Leader
Indo-Pacific Ocean Climate Variations
Research Team
Research Institute for Global Change
Japan Agency for Marine-earth Science
and Technology (JAMSTEC)
Tel: +81 46 867 9462
Email: andouk@jamstec.go.jp

REPUBLIC OF KOREA

Dr. Qtae Jo
Aquaculture Scientist
National Fisheries Research and
Development Institute (NFRDI)
Busan 619-705, Busan
Republic of Korea
Tel: +82 10 4431 8628
Mobile: +82 51 720 2432
Email: qtjo@nfrdi.go.kr

Dr. Kyung Tae Jung
Cheif Editor for Ocean and Polar
Research
Korea Ocean Research & Develop
Institute
Republic of Korea
Tel: +82 31400 6322, +82 1199882529
Email: ktjung@kiost.ac

Dr. Youn-Ho Lee
Principal Research Scientist/Professor
Marine Ecosystem Research Division
Korea Institute of Ocean Science
and Technology
787 Haean-ro, Sangnok-gu,
Ansan-si, Gyeonggi-do 426-744
Republic of Korea
Tel: +82 31 400 6428
Fax: +82 31 400 6425
Email: ylee@kiost.ac

Dr. Chul Park
Member of Group of Experts,
Regular Process
Department of Oceanography
Chungnam National University
Daejon 305-764, Republic of Korea
Tel: +82 42 821 6438
Fax: +82 42 822 8173
Email: Chulpark@cnu.ac.kr

MALAYSIA

Dr. Aileen Tan Shau Hwai
Prof. School of Biological Sciences
Universiti Sains Malaysia
11800 Penang, Malaysia
Tel : +604 653 3508
Fax: +604 653 3500
Mobile: +6012 4319900
Email: aileen@usm.my

Ms. Ezahtulsyahreen Binti Ab Rahman
Environmental Control Officer
Marine Data Unit, Marine and Water
Division Department of Environment
Putrajaya, Malaysia
Tel: +603 88712000
Fax: +603 88884070
Email: ezahreen@doe.gov.my

Mohd Nizam Basiron
Research Fellow
Centre for the Straits of Malacca
Maritime Institute of Malaysia
B-06-08 Megan Avenue II
12, Jalan Yap Kwan Seng
50450 Kuala Lumpur, Malaysia.
Tel: +603 2161 2960
Fax: +603 2161 4035
Email: nizam@mima.gov.my

PHILIPPINES

Dr. Gil Jacinto
Professor
Marine Science Institute
University of the Philippines Diliman
Quezon City, Philippines
Tel: +632 922 3944
Mobile: +63 917 811 8172
Fax: +632 924 7678
Email: gilj@upmsi.ph

Dr. Annadel Cabanban
c/o Sulu-Celebes Seas Sustainable
Fisheries Management Project
Suite 1801, 18th Floor
OMM CITRA Building
San Miguel Avenue, Pasig City
Metro Manila, Philippines
Tel: +632 5700064
Mobile: +63 929 158 2254
Fax: +632 5700064
Email: annadel.cabanban@gmail.com

Prof. Edgardo D. Gomez
The Marine Science Institute
University of the Philippines
Diliman, Quezon City 1101
Philippines
Tel: +632 981 8500 ext. 2908
Fax: +632 924 7678
Mb: +63921 9140755
Email: edgomezph@yahoo.com

Dr. Miguel D. Fortes
Marine Science Institute CS
University of the Philippines
Diliman, Quezon City 1101
Philippines
Tel: 632 922 3958(59)
Fax: 632 924 7678
Email: migueldfortes@gmail.com,

Dr. Porfirio M. Alino
The Marine Science Institute
University of the Philippines
Diliman, Quezon City 1101
Philippines
Email: pmalino2002@yahoo.com, pma-
lino@upmsi.ph

RUSSIA

Dr. Anatoly Kachur
Director, NOWPAP POMRAC
Deputy Director Pacific Geographical
institute
Far Eastern Branch of Russian
Academy of Sciences
7 Radio St. Vladivostok, 690041
Russian Federation
Tel: +74232 313071
Fax: +74232 312159
Email: kachur@tig.dvo.ru

Dr. Vladimir Shulkin
NOWPAP POMRAC
Head, Laboratory of Geochemistry
Pacific Geographical Institute
Far Eastern Branch of Russian
Academy of Sciences
7 Radio St. Vladivostok 690041
Russian Federation
Tel: +74232 320652
Fax: +74232 312833
Email: shulkin@tig.dvo.ru

SINGAPORE

Prof. Chou Loke Ming
Professor, Faculty of Science
Department of Biological Sciences
National University of Singapore (NUS)
14 Science Drive 4
Singapore 117543
Tel: +65 6516 2696
Fax: +65 6779 2486
Email: dbsclm@nus.edu.sg

Dr. Beverly Goh
Natural Sciences & Science Education
National Institute of Education
Nanyang Technological University
NIE7-03-88, 1 Nanyang Walk
Singapore 637616
Tel: +65 6790 3819
Fax: +65 6896 9414
Email: beverly.goh@nie.edu.sg

THAILAND

Dr. Anuwat Nateewathana
Marine Biodiversity Specialist
Department of Marine and
Coastal Resources
Ministry of Natural Resources
and Environment
5th Fl.,Building B,
Cheangwattana Rd.
Laksi, Bangkok 10210, Thailand
Email: anuwat007@gmail.com

Dr. Suchana Chavanich
Associate Professor
Chulalongkorn University
Reef Biology Research Group
Department of Marine Science
Faculty of Science
Bangkok 10330, Thailand
Tel: 662 218-5394
Fax: 662 255 0780
Email: suchana.c@chula.ac.th

Mr. Pirochana Saikiang
Senior Expert on Marine Fisheries
Department of Fisheries
6th Chulaphorn Building
Kasetklang, Chatuchak
Bangkok 10900, Thailand
Tel: +662 940 6525
Fax: +662 562 0571
Email: pirochas@hotmail.com

Ms. Pornsri Mingkwan
Environmental Scientist
Pollution Control Department
92 Soi Phaholyothin 7
Phaholyothin Road
Samsean-Nai, Phayathai
Bangkok 10400, Thailand
Tel: +662 298 2246
Fax: +662 298 2240
Email: pornsri.m@pcd.go.th

Capt. Bongkoch Samosorn
Operational Officer
Hydrographic Department
Royal Thai Navy
222 Rim Tang Rod Fai Kao Road
Bangna, Bangkok 10260, Thailand
Tel: +662 475 7067
Fax: +662 475 2249
Email: bsamosorn@gmail.com

VIETNAM

Mr. Le Dai Thang
Head of Division
Division of Management of Technical
Infrastructure for Marine Survey and
Control-Bureau of Marine Resources
and Environment Survey and Control
(VASI)
Ministry of Natural Resources and
Environment (MONRE)
No 10, Ton That Thuyet Street
Cau Giay District, Hanoi, Vietnam
Mobile: +84 93.616.62.26
Email: ldthang@monre.gov.vn, ldt-
thang@gmail.com

Mr. Nguyen Tan Douc
Researcher
Research Institute for the
Management of Seas and Islands
(RIMSI),Vietnam Administration of
Seas and Islands (VASI)
No. 25 Trung Kinh, Trung Hoa town,
Cau Giay Dist. Hanoi, Vietnam
Tel: +84 916 097 991
Fax: +84 432 595 429
Email: nguyentanduoc@gmail.com

Dr. Dao Van Hien
Bureau for Marine Resources and Envi-
ronment Survey and Control
Vietnam Administration of Seas and
Islands (VASI) Level 17
10 Ton That Thuyet, Cau Giay
District, Hanoi, Vietnam.
Mobile: +849 4850 3557
Email: hienvdao@gmail.com, hienvdao@
yahoo.com

Dr. Vo Si Tuan
Associate Professor on Marine Biology
Vice Director of Institute of Oceanog-
raphy
01 Cau Da street
Nha Trang city, Vietnam
Tel: +84 58 3590033
Fax: +84 58 3590034
Email: vosituan@gmail.com

Dr. Nguyen Chu Hoi
Department of Environmental Manage-
ment
Faculty of Environment
Hanoi University of Science (HUS)
334 Nguyen Trai Road
Thanh Xuan, Hanoi, Vietnam
Tel: +84 4 3558 3305
Fax: +84 4 3558 2872
Email: nchoi52@gmail.com

RESOURCE PERSONS and EXPERTS

Dr. Trevor J. Ward
Workshop Moderator
Greenward Consulting –
Marine Ecosystems and Biodiversity
Perth, Western Australia
Tel: +61 8 9387 2866
Email: tjward@bigpond.net.au

Dr. Peter T Harris
Senior Marine Science Advisor
Geoscience Australia
UNEP/GRID Arendal
Postboks 183, N-4802
Arendal, Norway
Tel: +47 47630434
Email: petertharris@gmail.com

Mr. Alan Simcock
Coordinator of Group of Experts
Regular Process
United Kingdom
Email: ajcsimcock@aol.com

Dr. Hugh Kirkman
5a Garden Grove
Seaholme, Vic 3018, Australia
Tel: +613 93150576
Mb: +614 39698249
Email: hughkirkman@ozemail.com.au

FAO

Dr. Rudolf Hermes
Chief Technical Advisor
Bay of Bengal Large Marine Ecosystem
Project (BOBLME)
c/o Andaman Sea Fisheries Research
& Development Center
77 Moo 7 Sakdidej Rd., Makham Bay
Tambon Vichit, A. Muang
Phuket 83000, Thailand
Tel: +66 76 391861
Fax: +66 76 391864
Email: rudolf.hermes@boblme.org

UNEP

Dr. Alexander TKALIN
Coordinator
Northwest Pacific Action Plan
(NOWPAP) of UNEP
NOWPAP RCU
152-1 Haean-ro, Gijang-up
Gijang-gun, Busan 619-705
Republic of Korea
Tel: +82 51 720 3001
Fax: +82 51 720 3009
Email: alexander.tkalin@nowpap.org

Dr. Elaine Baker
GRID-Arendal
The University of Sydney
NSW 2006, Australia
Tel: +61 2 93513000|
Fax: +61 2 9351 0184
Email: elaine.baker@sydney.edu.au

Dr. Ellik Adler
Co-ordinator, COBSEA Secretariat
UNEP/DEPI,
United Nations Building
2nd Floor, Block B
Rajdamnern Avenue
Bangkok 10200, Thailand
Tel: +662 288 1905
Fax: +662 288 1029
Email: Ellik.Adler@unep.org

Mr. Jerker Tamelander
Head, Coral Reef Unit
UNEP/DEPI
United Nations Building
2nd Floor, Block B
Rajdamnern Avenue
Bangkok 10200, Thailand
Tel: +662 288 1099
Fax: +662 288 1029
Email: jerker.tamelander@unep.org,
tamelander@un.org

Dr. Ampai Harakunarak
Task Manager GEF IW
UNEP/DEPI
United Nations Building
2nd Floor, Block B
Rajdamnern Avenue
Bangkok 10200, Thailand
Tel: +662 288 1977
Fax: +662 288 1029
E mail: ampai.harkunarak@unep.org

Mr. Reynaldo Molina
Consultant
COBSEA Secretariat
UNEP/ DEPI
United Nations Building
2nd Floor, Block B
Rajdamnern Avenue
Bangkok 10200, Thailand
Tel: +662 288 1860
Fax: +662 288 1029
E mail: Molinar@un.org

Ms. Yoon Young Back
Consultant
COBSEA Secretariat
UNEP
United Nations Building
2nd Floor, Block B
Rajdamnern Avenue
Bangkok 10200, Thailand
Tel: +662 288 1202
Fax: +662 288 1029
E mail: Youngy@un.org

Ms. Krittika Kleesuwan
Secretary,
COBSEA Secretariat
UNEP
United Nations Building
2nd Floor, Block B
Rajdamnern Avenue
Bangkok 10200, Thailand
Tel: +662 288 1889
Fax: +662 288 1029
E mail: Krittika.Kleesuwan@unep.org

Mr. Tobias Fast
Intern, Coral Reef Unit, DEPI
United Nations Building
2nd Floor, Block B
Rajdamnern Avenue
Bangkok 10200, Thailand
Tel: +662 288 1099
Fax: +662 288 1029
Email:ESCAP-UNEP-INTER2@un.org

UNESCO-IOC/WESTPAC

Mr. Wenxi Zhu
Head of IOC Regional Office for the
Western Pacific (WESTPAC)
Intergovernmental Oceanographic
Commission of UNESCO
c/o Department of Marine and
Coastal Resources
9th Fl. Governmental Complex B
120 Chaengwattana,
Bangkok 10210, Thailand
Tel: +66 2 141 1288
Fax: +66 2 143 9245
Email: w.zhu@unesco.org

Dr. Somkiat Khokiattiwong
Chairperson of IOC Sub-Commission
for the Western Pacific (WESTPAC)
Head of Oceanography and
Marine Environment
Phuket Marine Biological Center
Department of Marine and
Coastal Resources
51 Sakdhidej Rd. Muang District
Phuket 83000, Thailand
Tel: +66 76 391128
Fax: +66 76 391127
Email: skhokiattiwong@gmail.com

Ms. Nachapa Saransuth
Administrative and Programme
Assistant
IOC Regional Office for the
Western Pacific (WESTPAC)
Intergovernmental Oceanographic
Commission of UNESCO
c/o Department of Marine and
Coastal Resources
9th Fl. Governmental Complex B
120 Chaengwattana
Bangkok 10210, Thailand
Tel: +66 2 141 1288
Fax: +66 2 143 9245
Email: n.saransuth@unesco.org

Ms. Thapupsorn Hnoonim
Administrative Assistant
IOC Regional Office for the Western
Pacific (WESTPAC)
Intergovernmental Oceanographic
Commission of UNESCO
c/o Department of Marine and
Coastal Resources
9th Fl. Governmental Complex B
120 Chaengwattana
Bangkok 10210, Thailand
Tel: +66 2 141 1448
Fax: +66 2 143 9245
Email: t.hnoonim@unesco.org

Annex 2: Provisional Workshop Agenda

Day 1 – Monday, 17 September 2012

08:30 – 09:00	Registration
09:00 – 09:10	**Welcome Remarks** Dr. Ellik Adler, UNEP and COBSEA Dr. Somkiat Khokiattiwong, IOC/WESTPAC Dr. Elaine Baker, GRID Arendal Dr. Alexander Tkalin, NOWPAP
09:10 – 10:30	**Introduction Presentations** Background presentation on the Regular Process – World Ocean Assessment – Mr. Alan Simcock Short summary of existing regional marine assessments – Dr. Juying Wang Introduction to workshop methodology – Dr. Trevor Ward
10:30 – 10:45	*Coffee Break and Group Photo*
10:45 – 12:30	**Working session to review/confirm Biodiversity parameters, grading statements, benchmarks (3 sheets)** Plenary activity. Sub-groups will be formed if needed Dr. Trevor Ward
12:30 – 13:30	*Lunch Break*
13:30 – 15:30	**Review/confirm Ecosystem health parameters, grading statements, benchmarks (2 sheets)** Plenary activity. Sub-groups will be formed if needed Dr. Trevor Ward
15:30 – 15:45	*Tea break*
15:45 – 18:00	Review/confirm Pressure parameters, grading statements, benchmarks (1 sheet) Plenary activity. Sub-groups will be formed if needed Dr. Trevor Ward
18:30 – 20:00	*Reception*

Day 2 – Tuesday, 18 September 2012

08:30 – 10:30	**Populate assessment sheet for habitats (Part 1)** Plenary activity Dr. Trevor Ward
10:30 – 10:45	*Coffee Break*
10:45 – 12:30	**Populate assessment sheet for species, ecosystem processes (Part 2 and 3)** 4 sub-groups Dr. Trevor Ward, Dr. Peter Harris, Dr. Elaine Baker and Mr. Alan Simcock Sub-group Chairs
12:30 – 13:30	*Lunch Break*
13:30 – 15:00	**Populate assessment sheet for species, ecosystem processes (Part 2 and 3 (continued)** 4 sub-groups Dr. Trevor Ward, Dr. Peter Harris, Dr. Elaine Baker and Mr. Alan Simcock Sub-group Chairs
15:00 – 15:30	**Part 2 and Part 3 – report back to Plenary** Dr. Trevor Ward
15:30 – 15:45	*Tea break*
15:45 – 18:00	**Populate assessment sheet for pests, physical/chemical processes (Part 4 and 5)** 4 sub-groups Dr. Trevor Ward, Dr. Peter Harris, Dr. Elaine Baker and Mr. Alan Simcock Sub-group Chairs

Day 3 – Wednesday, 19 September 2012

08:30 – 09:00 **Part 4 and Part 5 – report back to Plenary**
Dr. Trevor Ward and groups reporters

09:00 – 10:30 **Populate assessment sheet for pressures (Part 6)**
4 sub-groups
Dr. Trevor Ward, Dr. Peter Harris, Dr. Elaine Baker and Mr. Alan Simcock
Sub-group Chairs

10:30 – 10:45 *Coffee Break*

10:45 – 12:30 **Populate assessment sheet for pressures (Part 6)**
4 sub-groups
Dr. Trevor Ward, Dr. Peter Harris, Dr. Elaine Baker and Mr. Alan Simcock
Sub-group Chairs

12:30 – 13:30 *Lunch Break*

13:30 – 15:30 **Populate assessment sheet for pressures (Part 6)**
4 sub-groups
Dr. Trevor Ward, Dr. Peter Harris, Dr. Elaine Baker and Mr. Alan Simcock
Sub-group Chairs

15:30 – 15:45 *Tea break*

15:45 – 16:15 **Part 6 – report back to Plenary**
Dr. Trevor Ward and groups reporters
Risks, Management Effectiveness - discussion of assessment procedures
Dr. Trevor Ward

16:15 – 17:00 Workshop evaluation and feedback session

17:00 – 17:30 Plenary work

17:30 – 18:00 **Closing Remarks**

18:30 – 20:00 *Dinner*

Annex 3: Workshop Methodology

This document was issued to all intending participants in the Bangkok workshop; the content has been slightly amended subsequently to conform to the terminology adopted by the participants at the workshop, and the addition of graphics.

Short Description of Assessment Methodology and Workshop Process

Background

This assessment will consult experts to assemble information and review data, and to gauge expert opinion about the condition of the ocean's marine ecosystems across a broad range of values of the South China Sea. The assessment is a rapid assessment of expert opinion and, while this limits the resolution that can be applied to any single ocean value, the assessment as a whole draws from a wide base of parameters, minimising the risks of decision model failure in this context of regional ocean assessment. This approach explicitly trades-off a high-resolution assessment based on a few, well-known parameters against a lower-resolution assessment based on a broader base of less well-known parameters. This results in a lower resolution set of outcomes but is less biased in its approach to assessing condition. When outcomes are assembled across multiple spatial units (such as regions), this framework provides for a more powerful and less biased answer to the question of biodiversity condition at regional scales than the use of a small number of parameters with high levels of data/knowledge.

The Bangkok Workshop draws from the collective experience and knowledge of local and regional experts, and allows their judgements to be set within a specified decision model that can be systematically adapted to apply to ocean systems at a range of scales for the purposes of regional (and potentially global) assessment. The consultation and workshop process described here has been adapted from the broad approach and decision model established for the assessment and reporting of Australia's national marine environment (Australia State of the Environment 2011; www.environment.gov.au/soe).

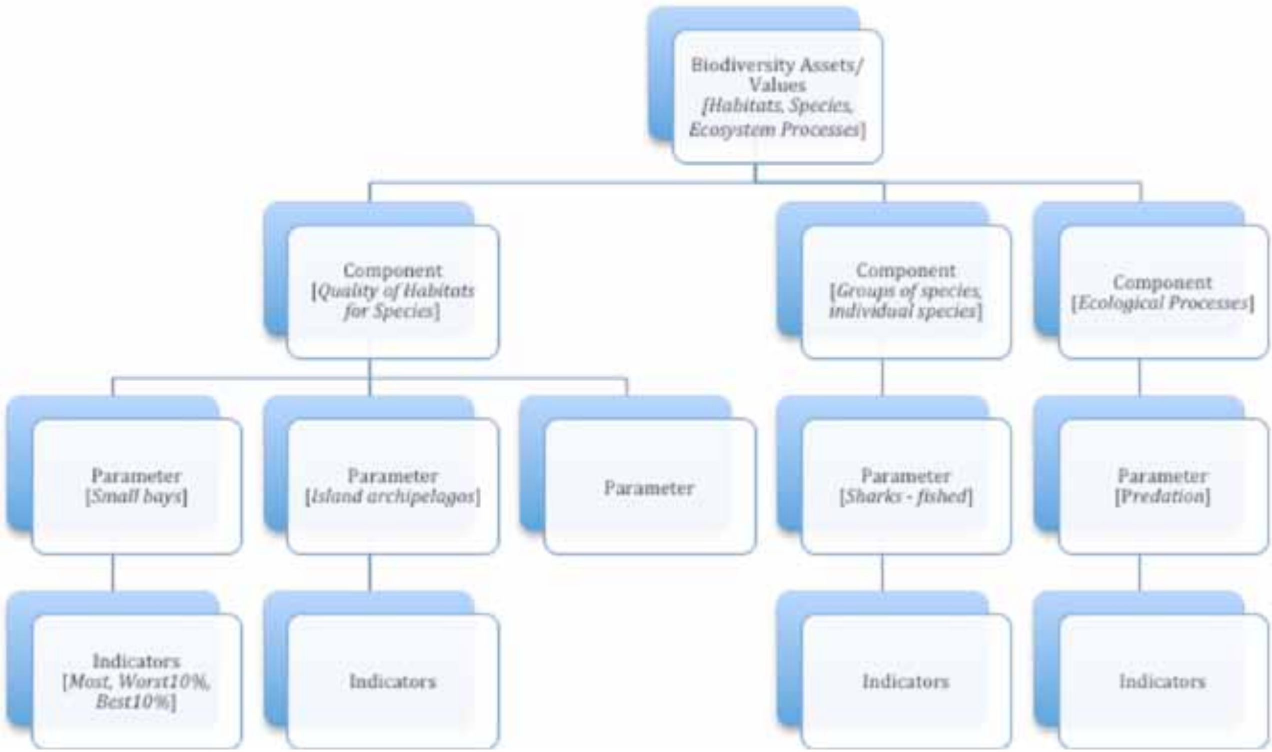
Decision Model

The Bangkok Workshop will focus on biodiversity, ecosystem health and pressures on the LMEs of South China Sea and Gulf of Thailand. The decision model consists of a hierarchical arrangement of the Assets/Values, Assessment Components, Parameters, and Indicators (see below for some examples of this hierarchy). The expert judgements made about these aspects are aggregated in an explicit manner within the structure of the decision-making framework to provide the raw information for reporting on the region. The expert data/knowledge elicited at the workshop is used in this structure through a set of coarse-grade scoring and aggregation procedures, including any weightings that might be either explicitly required by the experts or inferred through the structural architecture of the model, to reach a final set of judgements about each of the Assets/Values. The assessment requires scores/grades (where possible) to be assigned to both Indicators of condition and trend for each Parameter, and an estimate of confidence in both condition and trend.

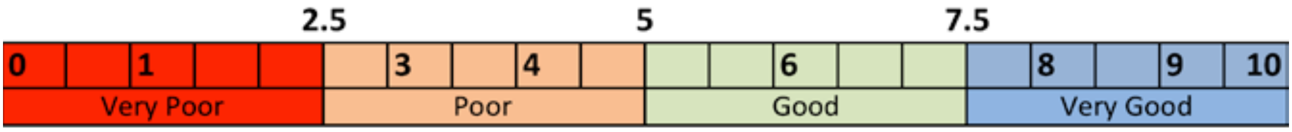
Scoring and Grading

At the workshop, scores will be assigned (by the expert participants) to each Indicator on a scale from 0 to 10, where 0 is consistent with the weakest level of performance or achievement of the grading criterion (see below for the grading criteria), and 10 is the strongest or highest level of achievement.

The Grades are coarse levels of condition performance/achievement used for reporting purposes at the Indicator level: Very Poor, Poor, Good, and Very Good. These should be used in navigating towards an agreed score, and are subsequently reconstructed (post-workshop) from the expert-assigned scores, using linear thresholds of 2.5, 5, and 7.5.



The form of the Decision Model for condition assessment, with some specific examples.



Graphical representation of the condition grades and associated numeric scoring structure.

Grading Criteria Statements

The Grading Statements (shown below) have been uniquely derived for each set of assessment Parameters. Grading Statements provide criterion-style guidance to inform the experts about the thresholds they should use in determining first a grade and then a score that is consistent with their knowledge of the data and information, and best represents their judgement at the Indicator level of the Decision Model.

Reference Points

The score/grade assigned to an Indicator is formed by the experts based on relativity to a reference point. The reference point is established as a point of reference for the decision framework. For the biophysical indicators, the reference should be set generically as the condition that would have existed prior to the commencement of the major changes in type and intensity of use and exploitation of the region, and can be considered to best represent a relatively natural set of conditions perhaps only slightly impacted by human activities. This will usually require a surrogate to be adopted, or for some aspects, a set of modelled hind-cast estimates may be appropriate and available. In some cases, a reference point will need to be developed to represent highly desirable conditions that are known to have existed previously, such as provision of services or recovery of biomass or habitat distributions.

For the purposes of the Bangkok Workshop, the reference points for biodiversity, ecosystem health and environmental, social and economic pressures are set to represent the conditions prevailing in about 1900. It is clear that the conditions at that time are not 'pristine' or unaffected by human civilisation, however this is a time before the extensive use of mechanised power for maritime purposes, including fishing, and can reasonably be expected to represent a time when there was only a limited set of human-derived impacts in the region. While it is clear that the best data to inform analysis of conditions are likely to be available from more recent times, at least for some parameters, the choice of an early time is critical if natural and undisturbed conditions are to be used as the reference framework for the assessment and if the widest possible diversity of parameters is to be included in the assessment. Conversely, constraining the assessment to conditions that are data-rich and recent imposes a false sense of power in the assessment and its outcomes, principally because data availability is often confounded with environmental degradation/impacts, and it may limit parameter choice, and these both apply a systematic bias that is very difficult to uncouple from the assessment process.

The form of reference point for the social and economic indicators will be framed on the type and extent of pressure that is being applied to social and economic assets/values through the causal chain of alterations in the environmental assets/values.

The use of a reference point here should not be confused with the setting of a target or an objective for current management systems to achieve. Reference points as established in this Decision Model are used for 'anchoring' the scoring and grading system to a common point of reference across regions, and to encourage consistent scoring within and across regions that will contribute to a more balanced aggregated form of regional assessment. Reference points used here do not infer that such conditions should, or even could, be used to establish the targets for local-scale restoration efforts or national/regional management. This assessment will provide a regional overview of the relative condition of the parameters, and provide coarse-scale input to regional priorities to address biodiversity issues. Within this broad context, national and local-scale initiatives may then be developed outside the context of the WOA, to specifically address fine scale issues that may be contributing to the regional-scale patterns.

Parameters

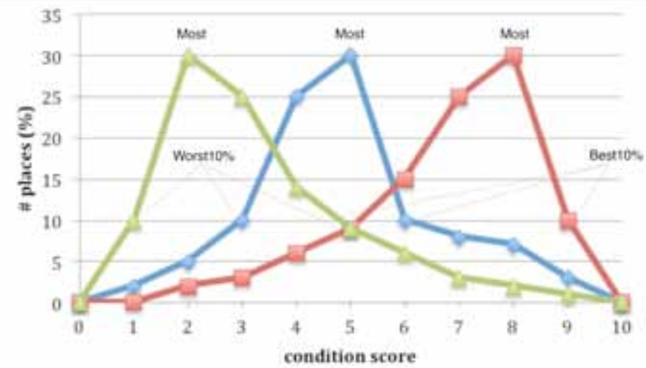
The Parameters elements of the Assets/Values are divided into two groups: generic aspects that will apply to many other ocean regions, and region-species groups that will contain mainly Assets/Values that are unique to the region under consideration. All Parameters are assessed based on the score/grade assigned to an Indicator for each Parameter (such as 'most places'), and ultimately aggregated, graded and reported at the regional levels. Where possible, the Parameters should be defined at a level of aggregation that is applicable globally to regions of similar types, so that the regional assessment may be consistent and coherent with assessments in other regions. The Parameters have been assigned in natural groups, comprising a number of related members, as a Parameter. In species groups, for example, an Indicator to be assessed might be 'sharks', perhaps with separate species-specific components for high profile species such as 'Great Whites', 'Whale Sharks', etc., or groups of small and non-targeted species. It may also be appropriate to identify other groupings, such as 'targeted sharks' by size, by family or by some other natural grouping. While there is no upper limit on the number of Parameters that could be assessed, the practicalities of the Bangkok Workshop (such as the timeframe, resources available, the scale of the report, etc) indicate that a maximum number of between 20 and 40 Parameters for each set of Assets/Values will bring an acceptable level of resolution to the regional assessment problem.

In reviewing the list of Parameters, experts should pay particular attention to the question of parameter weightings within the decision structure. For example, resolving fish into component species for individual Parameter Assessment at the workshop will heavily increase the weighting of fish species in the final outcome, and this might not properly reflect the importance of fish in answering the WOA question of overall biodiversity condition in the region.

Scoring Indicators

The Indicators comprise these reporting quantities (or metrics): 'Most places', 'Worst 10% places' and 'Best 10% places' for Condition, and Increasing, Decreasing or Stable for Trend (relative to changes that have occurred over the last 5 years). Expert judgement should be applied at the scale of the whole region, and not be overly influenced by small areas of very good or very bad condition, or small areas where changes are very great—treat the scoring process as attempting to assign a median estimate within the established scoring categories.

Sampled estimates of the condition quality of any individual Parameter will be distributed across a range of values. Commonly, this knowledge/data will be related to the spatial distribution of the Parameter, but not always. Some forms of data/knowledge for some Parameters may not be spatially arranged, such as estimates of the size of the population of a well-researched species. However, the Indicators should be interpreted to apply to the distributional range of values, expressed in terms of spatial distribution if possible. If a spatial structure cannot be inferred, these Indicators can be simply interpreted (on a Parameter basis) as reflecting the statistical distribution of condition values. The intention of this form of Indicator structure is to reflect not only the mode (or more crudely a median or 'average') score for a Parameter, but to also assign an estimate of the condition at the ends of the distribution of condition values. The Indicator '10%' has been chosen to try to ensure that scoring is not con-



A schematic representation of three different distributions of scores for a hypothetical parameter, showing how the scores for Best10%, Most and Worst10% indicators can vary depending on the underlying frequency distribution.

fined to reporting the absolute worst (or best) known individual example of a Parameter, but reasonably reflects the condition in a group of examples of the Parameter at the extremes of the distribution of values. This information set (Most, Best, Worst) is an important component of ecosystem-based policy and management. It can be used as a powerful mechanism for reporting/tracking the effectiveness of management initiatives, and is a useful tool for aggregation into regional-scale and (potentially) global-scale reporting systems.

The rationale for scores assigned at the workshop will be noted in summary form (text dot points) in the matrix, assigned to each score so that the main factor(s) influencing your scores are documented. For example, although there may be no direct information about the condition of a habitat or species group, you may feel that this component of the environment is in 'good' condition because there are few obvious environmental pressures that have influenced its condition. Alternatively, you may feel that the factors that degrade some aspect of biodiversity condition today have operated previously, and so cause-effect relationships known from recent studies can be used to make estimates of earlier conditions using surrogate environmental factors.

Information Quality
This process is a form of rapid assessment, and draws upon the best data and expert knowledge within the resources available to complete the assessment. It is clear that resources are not available for a full technical synthesis and analysis of all information/data for the purposes of the assessment, and it is recognised that the resolution available for each Parameter is coarse (typically restricted to the level of the four performance grades). However, for the purposes of the World Ocean Assessment, this level of resolution (both the accuracy and precision) across large numbers of individual parameters provides a modestly robust and low-bias decision structure for regional assessment purposes, and can be efficiently compiled within regions to provide a rapid assessment of their marine environments with a known resolution and level of certainty.

For estimates of condition, trend, and importance of factors affecting the environment, the participants should assign estimates of the level of confidence in the information base they used to make their judgements. Uncertainty and reliability contributing to confidence in the knowledge should cover all aspects of the information base, including such matters as technical quality/robustness, spatial and taxonomic coverage, process uncertainty, all forms of model uncertainty, and access to appropriate levels of detail.

The grading statements for the estimates of Confidence are:
High: Adequate high quality evidence and high level of consensus
Moderate: Limited or low quality evidence or limited consensus
Low: Evidence and consensus too low to make an assessment

Elicitation Bias
The assessment process designed and being trialled in the Bangkok workshop is subject to a number of potential sources of bias. These include such matters as a limited representation of the extant knowledge base at the workshop (including insufficient experts in attendance), and the other forms of bias always inherent in a Delphi-style rapid assessment process. The most important aspect of this matter is recognising the type and extent of bias that may apply, and where any aspect may be important (with respect to the coarse resolution of the overall process), the existence of such bias will be documented in the workshop outcome. Participants at the workshop will be guided to recognise each of the main forms of elicitation bias that apply to assessment processes such as is applied in the workshop.

Condition Assessments

Guidance for Scoring at the Workshop
For each Parameter in the condition matrices, assign a score that represents your overall estimate of condition, ranging between 0 (Worst) to 10 (Best) for current (2007-2012) condition, guided by the Grading Statements (as below). Your score is required for three Indicators/metrics for each Parameter: 'Most', the 'Best 10%' and the 'Worst 10%', representing the notional frequency distribution of scores across the spatial grouping or distribution of values of the indicator being assessed. Also, assign an estimate of High, Medium or Low that represents the level of confidence that you consider surrounds your estimate of the condition (types of uncertainty contributing to confidence are discussed further below). Benchmark your judgement against natural conditions and trends, an earlier time in development of the region considered to be a condition of high quality, or such other generic but specified reference point as may be agreed at the workshop (proposed to be conditions applying in about 1900). Please keep in mind these two important aspects: (a) the spatial scope of the region being assessed, which encompasses the area from highest tidal influence at the shoreline of the islands and continental coastline out to the edge of the spatial region, and including any river deltas and bays etc. that are influenced by tidal conditions, and any high seas; and (b) benchmark your estimate of condition against the condition established as the reference point, or any reasonable surrogate for that point.

For Trends, assign one of the three categories of current trend over the past 5 years (2007-2012) in the condition of the Parameter, assigned relevant to the grading statements: I=improving; D=deteriorating; S=stable. Note that Stable is intended to include the natural dynamics of the component, and does not infer a lack of natural variability (such as the natural dynamics in space or time).

For Trend, also provide an estimate of your confidence in the assignment, using High, Medium, or Low.

Grading Statements

This set of statements provides guidance and a basis for scoring and grading of Indicators established to assess and report on the Parameters.

Marine Biodiversity *(this deals with the structural and functional aspects of biodiversity)*	
P1: Quality of Habitat for Species	*Applies to habitat components and what is best understood about their status and trends expressed in terms of habitat quality for species*
Very Good (>7.5-10)	All major habitats are essentially structurally and functionally intact and able to support all dependent species
Good (>5-7.5)	There is some habitat loss, degradation or alteration in some small areas, leading to minimal degradation but no persistent substantial effects on populations of dependent species
Poor (>2.5-5)	Habitat loss, degradation or alteration has occurred in a number of areas, leading to persistent substantial effects on populations of some dependent species
Very Poor (0-2.5)	There is widespread habitat loss, degradation or alteration, leading to persistent substantial effects on many populations of dependent species
P2: Populations of Species and Groups of Species	*Applies to the major structural components and what is best understood about their status and trends expressed in terms of populations and groups of species (abundance, size/age structure, geographic distribution); this includes threatened species which may be assessed by species or as groups of species*
Very Good (>7.5-10)	Only a few, if any, species populations have declined as a result of human activities or declining environmental conditions
Good (>5-7.5)	Populations of a number of significant species but no species groups have declined significantly as a result of human activities or declining environmental conditions
Poor (>2.5-5)	Populations of many species or some species groups have declined significantly as a result of human activities or declining environmental conditions
Very Poor (0-2.5)	Populations of a large number of species or species groups have declined significantly as a result of human activities or declining environmental conditions
P3: Ecological Processes	*applies to what is best understood about the status and trends (abundance, distribution, rates) in the main ecological processes and effects of human activities*
Very Good (>7.5-10)	There are no significant changes in ecological processes as a result of human activities
Good (>5-7.5)	There are some significant changes in ecological processes as a result of human activities in some areas, but these are not to the extent that they are significantly affecting ecosystem functions
Poor (>2.5-5)	There are substantial changes in ecological processes as a result of human activities, and these are significantly affecting ecosystem functions in some areas
Very Poor (0-2.5)	There are substantial changes in ecological processes across a wide area of the region as a result of human activities, and ecosystem function is seriously affected in much of the region

Marine Ecosystem Health *(this deals with the processes affecting biodiversity)*	
P4: Physical and Chemical Processes	*Applies to what is best understood about the status and trends in the main physical and chemical processes (abundance, distribution, rates) as a result of human activities. The grading scale is based on a gradient in impacts of change.*
Little change/impact (>7.5-10)	There are no significant impacts of changes in physical or chemical processes as a result of human activities
Some change/impact (>5-7.5)	There are some significant impacts of changes in physical or chemical processes as a result of human activities in some areas, but these are not to the extent that they are significantly affecting ecosystem functions
Major change/impact (>2.5-5)	There are substantial impacts of changes in physical or chemical processes as a result of human activities, and these are significantly affecting ecosystem functions in some areas
Extreme change/impact (0-2.5)	There are substantial impacts of changes in physical or chemical processes across a wide area of the region as a result of human activities, and ecosystem function is seriously affected in much of the region
P5: Outbreaks of Pests, Invasive Species, Diseases and Algal Blooms	*Applies to what is best understood about the status and trends in the main outbreaks (frequency, distribution, densities). These matters are considered here as symptoms of ecosystem health.*
Very Good (>7.5-10)	The incidence and extent of diseases and algal blooms are at expected natural levels, and there are insignificant occurrences or outbreaks of pests, and the numbers and abundance of invasive species are minimal
Good (>5-7.5)	Diseases or algal blooms occur occasionally above expected occurrences or extent, and recovery is prompt with minimal affect on ecosystem functions; pests sometimes present and have been found at levels above natural occurrences but with limited ecosystem impacts; the occurrence, distribution and abundance of invasive species are limited and have minimal impact on ecosystem functions
Poor (>2.5-5)	Diseases or algal blooms occur regularly in some areas above natural levels of occurrence or extent; occurrences of pests require significant intervention or have significant effects on ecosystem function; occurrence, distribution and abundance of invasive species trigger management responses, or have resulted in significant impacts on ecosystem functions
Very Poor (0-2.5)	Disease or algal blooms occur regularly across the region at unnaturally high levels; occurrences of pests or invasive species are uncontrolled in some areas and are seriously affecting ecosystem functions

Factors Affecting the Environmental Values: Pressures/Threats *(this deals with high level pressure/threat factors that are, or are likely, affecting the biodiversity and environmental values of the bioregion)*	
P6: Impacts on Environmental Values	*Applies to what is best understood about the status and trends in the main factors affecting the biophysical environment*
Very Good (>7.5-10)	There are few or negligible current impacts from this factor, and future impacts on the environmental values of the region are likely to be negligible.
Good (>5-7.5)	There are minor current impacts in some areas, and future impacts from this factor on the environmental values of the region are likely to be minor and localised
Poor (>2.5-5)	The environmental impacts of this factor are currently significantly affecting the values of the region, and serious environment degradation is likely to occur within 50 years.
Very Poor (0-2.5)	The current and predicted environmental impacts of this factor are widespread, irreversibly affecting the values of the region, and there is widespread and serious environment degradation, or this is likely across the region within 10 years.
Impacts on Social and Economic Values	Applies to what is best understood about the status and trends in the consequences/importance of main pressure/threat factors affecting the social and economic values
Very Good (>7.5-10)	There are few or negligible environmental current impacts from this factor, and future consequent impacts on the social or economic values of the region are likely to be negligible.
Good (>5-7.5)	There are minor current environmental impacts in some areas, and future consequent impacts on the social or economic values of the region are likely to be minor and localised
Poor (>2.5-5)	The environmental impacts of this factor are currently significantly affecting the social or economic values of the region, and serious degradation is likely within 50 years.
Very Poor (0-2.5)	The current and predicted environmental impacts of this factor are widespread, irreversibly affecting the social or economic values of the region, and there is widespread and serious further degradation and impacts, or this is likely across the region within 10 years.

Proforma Workshop Decision Matrices (Round 2)

Part 1: Habitats – Quality for Species
Reference Point = conditions in 1900

Habitat Systems	Parameter	Summary Rationale	Current Condition (*0 to 10 compared to reference point*)				Current Trend (*Improving, Stable, Declining*)			
			Best 10%	Most places	Worst 10%	Confid-ence H, M, L	Best 10%	Most places	Worst 10%	Confid-ence H, M, L
Benthic	Estuaries and deltas									
	Small gulfs and bays									
	Lagoons – open and barred									
	Beaches									
	Non-coral reefs fringing coasts and islands (intertidal and subtidal)									
	Coral reefs fringing coasts and islands (intertidal and subtidal)									
	Sub tidal and intertidal coral and rocky reefs not contiguous with shoreline									
	Seabed inner shelf (0-50m)									
	Seabed outer shelf (50-200m)									
	Seabed shelf break and upper slope									
	Slope (700-1500m)									
	Seabed abyss (>1500m)									
Water column	Water column shoreline (0-20m)									
	Water column inner shelf (20-50m)									
	Water column outer shelf (50-200m)									
	Water column offshore (>200m)									
Biological	Mangroves									
	Seagrass beds									
	Algal beds									
	Coral reefs (<30m)									
	Deepwater corals and sponges (>30m)									
	Bryozoan reefs									
	Mudflats									
Structural	Canyons and shelf-break									
	Seamounts (>1000m rise from seafloor)									
	Large gulfs, large bays									
	Offshore banks, shoals, islands									
	Major river deltas/wetlands									
	Karst systems									

Part 1: Habitats – Quality for Species (continued)

Special individual habitat features										
	Ha Long Bay WH									
	Bight of Bangkok									
	Mekong Delta									
	Coast of Hong Kong									
	Jakarta Bay									
	Sihanouvkville Bay									
	Lingayen Gulf									
	Tubbataha Reef WHS									
	Palawan Biosphere Reserve									
	Verde Island Passage									
	Batanes Islands									
	NIPAS MPA									
	Natuna Archipelago									
	Upper Gulf of Thailand									
	Lower Gulf of Thailand									

Part 2: Species Populations and Groups
Reference Point = conditions in 1900

Groups	Parameter	Summary Rationale	Current Condition (*0 to 10 compared to reference point*)				Current Trend (*Improving, Stable, Declining*)			
			Best 10%	Most places	Worst 10%	Confid-ence H, M, L	Best 10%	Most places	Worst 10%	Confid-ence H, M, L
Mammals	Whales - baleen									
	Whales - toothed									
	Dolphins, porpoises									
	Dugongs									
Fish	Sharks and rays - targeted and bycatch									
	Sharks and rays - non exploited									
	Great white shark									
	Whale shark									
	Tuna and billfish									
	Inner shelf (0-50m) demersal fish species									
	Outer shelf (50-200m) demersal & benthopelagic fish species									
	Slope - demersal fish species (>200m)									
	Meso-pelagic fish species									
	Small pelagics - inner shelf (0-50m)									
	Small pelagics - outer shelf (50-200m)									
	Inner-shelf reef fish species (0-50m)									
	Inner-shelf demersal fish species (0-50m)									
	Grazers/herbivores of coral reefs									
Invertebrates	Inner shelf – squid etc									
	Inner shelf - crustaceans									
	Inner shelf – other invertebrate spp.									
	Outer shelf & inner slope invertebrate spp.									
	Shoreline and intertidal soft sediment invertebrate spp.									
	Shoreline and intertidal rocky shore invertebrate spp.									
	Benthic filter feeders of soft and hard subtrata									
	Hard coral species									

Part 2: Species Populations and Groups (continued)

Birds	Seabirds - resident									
	Migratory seabirds/waders									
Reptiles	Turtles									
	Seasnakes									
	Crocodiles									
Plants	Mangrove species									
	Seagrass species									
	Algae species									
	Dune, saltmarsh, foreshore species									
Additional key species, specially protected or iconic species groups										
	Seahorses and pipefish									
	Holothurians									
	Triton gastropods (*Charonia spp*)									
	Giant clam (*Tridacna spp*)									
	Coelacanth									
	Groupers									
	Urchins *(Tripnuestes gratilla)*									
	Protected species of ornamental reef fish									
	Crown of Thorns starfish									
	Lobsters (spiny)									
	Butterfly fish									

Part 3: Ecological Processes
Reference Point = conditions in 1900

Type	Parameter	Summary Rationale	Current Condition (*0 to 10 compared to reference point*)				Current Trend (*Improving, Stable, Declining*)			
			Best 10%	Most places	Worst 10%	Confid-ence H, M, L	Best 10%	Most places	Worst 10%	Confid-ence H, M, L
Connectivity	Spatial/physical disjunctions									
	Biological, migration, flyways									
	Recruitment, settlement									
	Genome structures, genetic adaptation									
	Nesting, roosting, spawning and nursery sites									
	Feeding grounds									
Productivity	Trophic structures and relationships									
	Water column, pelagic productivity									
	Benthic productivity-inshore									
	Benthic productivity-offshore									
	Reef building									
	Symbiosis: fish, corals, molluscs									
	Predation									
	Herbivory									
	Filter feeding									
	Microbial processes									
Additional key processes										
	Epiphytism									
	Succession									
	Turnover									
	Source-Sink relationships									

Part 4: Physical and Chemical Processes
Reference Point = conditions in 1900

Type	Parameter	Summary Rationale	Current Condition (*0 to 10 compared to reference point*)				Current Trend (*Improving, Stable, Declining*)			
			Best 10%	Most places	Worst 10%	Confid-ence H, M, L	Best 10%	Most places	Worst 10%	Confid-ence H, M, L
Transport mechanisms	Ocean currents, structure and dynamics									
	Storms, cyclones, wind patterns									
Sediment regime	Sediment inputs									
	Sediment transportation									
	Coastal/shoreline erosion									
Light regime	Inshore water turbidity, transparency and colour									
Temperature regime	Sea temperature, including SST									
Sea level	Sea level change									
Nutrient supply, cycling	Nutrient supply and cycling: land-based (land sourced nutrients supplied by river or stream)									
	Nutrient supply and cycling: ocean-based									
	Freshwater inflow, surface and groundwater runoff									
Components	Toxins, pesticides, herbicides									
	Dumped wastes									
	Radionuclides									
	Ocean acidity									
	Ocean salinity									
	Low oxygen-dead zones									
	Groundwater salinity									
	Coastal land salinity/acidity									
	Seaweed/seagrass wracks									
	Marine debris									
Physical Features	Major currents									
	Major upwellings									
	Oceanic fronts									

Part 4: Physical and Chemical Processes (continued)

Air–sea Interactions	Air-sea nutrient fluxes, air-sea gas exchange									
	Air-sea chemical, pollutant inputs									
	Atmospheric forcing via rainfall, wind, air temperature									
	Extreme climate events									

Part 5: Pests, Invasive Species, Diseases and Algal Blooms
Reference Point = conditions in 1900

Type	Parameter	Summary Rationale	Current Condition (*0 to 10 compared to reference point*)				Current Trend (*Improving, Stable, Declining*)			
			Best 10%	Most places	Worst 10%	Confid-ence H, M, L	Best 10%	Most places	Worst 10%	Confid-ence H, M, L
Pests (declared)	Number and abundance of declared pest species									
Invasive Species	Abundance and distribution of introduced species									
	Frequency, abundance distribution of jellyfish blooms									
Diseases	Number and extent of outbreaks of viral, bacterial, and fungal diseases									
	Number and extent of outbreaks of parasitic infestations									
	Number and extent of fish-kills									
Algal Blooms	Frequency, abundance distribution of algal blooms									
	Frequency, abundance distribution of *harmful* algal blooms									
Biofouling	Frequency, abundance distribution of biofouling									

Part 6: Factors Affecting Environmental Values – Threats/Pressures

This is an assessment of the broad-scale and high-level groups of threats that are detrimentally influencing the condition of the environment across the region. The score is an assessment of the broad significance of the threat to the identified assets/values across the region, based on the environmental, social and economic consequences of the threat. The scale of the threat (global, regional, local) primarily contributing to the score should be annotated. The indicators to be scored/graded are the same as in the previous parts of the assessment: condition and trend in Best10%, Most, Worst10% of the distribution, and confidence.

Reference Point = conditions in 1900

Note that the Bangkok Workshop did not proceed to assign scores or grades to the social & economic impacts components or parameters – the participants recommended at the workshop that an expanded set of experts would be required to enable the scores/grades to be robustly assigned.

Source	Factors detrimentally affecting the current condition	Summary rationale
Climate change and variability	Environmental impacts: Sea level, wind fields, storms (frequency, intensity), storm surges, rainfall pattern, acidity, current strength, productivity, temperatures, coastal erosion/accretion	*(identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts	*(Identify the social & economic assets/values affected)* could include e.g. coastal stability, land salinization, groundwater salinization, reduced wetland production, reduced subsistence fishing, river navigability, reduced coastal property protection, disruptions in normal activities (e.g. health, education, etc.), post-hazard epidemics, loss of lives.
Extreme climate events	Environmental impacts:	*(identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts	*(Identify the social & economic assets/values affected)*
Coastal urban development	Environmental Impacts: Housing, roads, recreation areas, etc on coastal foreshores and adjacent areas (beaches, dunes, wetlands, bays, islands, estuaries), sewage, groundwater, stormwater, algal blooms, local hydrology and meteorology,…	*(identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts	*(Identify the social & economic assets/values affected)*

Part 6: Factors Affecting Environmental Values – Threats/Pressures (continued)

River discharges	Environmental Impacts: freshwater plumes, water extraction for agriculture, dam-building, sediment loads, pollutant loads, nutrient loads, on nearshore reefs, fish stocks, seagrasses, etc	*(Identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts	(*Identify the social & economic assets/values affected)* e.g. navigation channels, coastal stability, foreshore erosion, flooding/drowning of lowlands, etc
Coastal Wetland Conversion	Environmental Impacts: loss of natural habitats – saltmarshes, mangroves; loss of coastal protection, loss of carbon sinks/sources, loss of useful connections with other ecosystems, potential release of unwanted gases (methane, H2S), Introduction of unwanted species,…	*(Identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts Introduction of pests, diseases, shift in livelihoods, loss of information and cultural sources,…	*(Identify the social & economic assets/values affected)*
Land Reclamation	Environmental Impacts: loss of natural habitats, change in hydrology, change in sediment cycling to and from beaches, modification of natural hydrology, increased water turbidity and nutrients, destruction of donor sites, loss/reduction of biodiversity, offsite pollution	(*Identify the assets/values from P1-P5 that are affected*)
	Social & Economic Impacts Increase in number of illegal households, shift in livelihoods, decrease/increase in land value	(*Identify the social & economic assets/values affected*)
Port facilities	Environmental Impacts: Terrestrial infrastructure and access, channels and designated port ownership/vesting of coastal waters, sea dumping, change in hydrology, oil/fuel spills	(*Identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts Increase in number of illegal households, shift in livelihoods, decrease/increase in land value	(*Identify the social & economic assets/values affected*) e.g. contamination of seafood, loss of fishing grounds, interference with aquaculture sites, increased risk of oil spills and groundings that affect fishing and aquaculture
Oil and gas exploration and production	Environmental Impacts: Seismic surveys, drilling, platforms, pollutants, oil spills,..	(*Identify the assets/values from P1-P5 that are affected*)
	Social & Economic Impacts	(*Identify the social & economic assets/values affected*) e.g. loss or contamination of fishing grounds
Fishing	Environmental Impacts: Impacts of live-fish fishing, trawling etc on harvest on population size and structure, impacts on non-target species, impacts on habitat	(*Identify the assets/values from P1-P5 that are affected*)
	Social & Economic Impacts	(*Identify the social & economic assets/values affected*) e.g. loss of subsistence fisheries, decrease in CPUE, serial depletion of valuable species, etc.

Part 6: Factors Affecting Environmental Values – Threats/Pressures (continued)

Aquaculture, including sea cages and on-shore ponds	Environmental Impacts: pollution of waterways, loss of shoreline habitat, shallowing of channels, disruption to groundwater, vector for disease to native species, escapes impact on native species, escapes of non-native species, excessive use of antibiotics, eutrophication, biodiversity loss,....	(*Identify the assets/values from P1-P5 that are affected)* e.g. impacts on local hydrology, alienation of natural habitats and species, nutrient and chemical pollution, etc.
	Social & Economic Impacts Reduction in income of true residents (foreign investors gain), loss of livelihood (lives) during fish kills, price increase of associated commodities	(*Identify the social & economic assets/values affected)* e.g. mangrove loss impacts on fish stocks, etc.
Eutrophication from coastal sources	Environmental Impacts: pollution of coastal waters and habitats, biodiversity loss, increase in pest species,..	*(Identify the assets/values from P1-P5 that are affected)* e.g. seagrass and corals affected by algal growth, algal blooms, etc.
	Social & Economic Impacts Reduction of access to recreation and resources,	*(Identify the social & economic assets/values affected)* e.g. reduction in navigable waterways, loss of subsistence fishing grounds, impacts on valuable fish species, etc.
Tourism islands and developments	Environmental Impacts: Litter, nutrients, boat scours, moorings, other development impacts, Biodiversity loss, coastal erosion, sewage, potable water, vectors of diseases	(*Identify the assets/values from P1-P5 that are affected)* Damage to seagrass beds, coral reefs, change in hydrology, smothering, turbidity; Exceeds island carrying capacity
	Social & Economic Impacts Transmitted diseases, acculturation, loss of identity (dignity), price increases, people/community displacement	*(Identify the social & economic assets/values affected)*
Marine Debris	Environmental Impacts Impacts on native species including mammals, reptiles and birds; impacts on fisheries foodchains, aquaculture systems, …	*(Identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts coastal amenity, fishery values, foreshore land values,..	*(Identify the social & economic assets/values affected)*
Power generation	Environmental Impacts: waste heat, radioactive wastes from accidents, habitat alienation from coastal infrastructure,..	*(Identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts community shifts (from shifts in thresholds)	*(Identify the social & economic assets/values affected)*
Desalination facilities	Environmental Impacts: Hypersaline water, waste heat, waste nutrients, habitat alienation from coastal infrastructure,..	*(Identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts	*(Identify the social & economic assets/values affected)*
Foreshore protection with hard substrates	Environmental Impacts: Habitat conversion, enhanced erosion from hard substrates,..	*(Identify the assets/values from P1-P5 that are affected)*
	Social & Economic Impacts	*(Identify the social & economic assets/values affected)*
Mining	Environmental Impact Loss of habitat, slope stability and protection, biodiversity, low water quality, hazardous chemicals, ore spills	*(Identify the assets/values from P1-P5 that are affected)*
	Socioeconomic Impact Reduction of access to natural resources by local peoples, displacement of IPs, loss of ancestral domain, ..	*(Identify the social & economic assets/values affected)*

Annex 4: Analysis Examples

The data provided by the experts at the workshop may be utilised in a number of ways for assessment and prioritisation purposes in addition to the regional overview of the full dataset discussed in the main body of the report.

Here, two further prospective examples for use of the data are summarised. First, the data are used to identify biodiversity of the region, selected from across all the biodiversity parameters scored at the workshop, that are in good (or at least the best available) condition, and may offer improved levels of protection (which could be through, say, a combination of a region-wide protected areas programme coupled with targeted reduction in pressures). Second, the data is used to identify of aspects of biodiversity that are highly degraded and, after further focused investigation, may be the target for recovery and restoration projects of region-wide importance.

The important underlying theme for these analyses is that they involve all the types biodiversity and ecosystem health parameters (habitats, species groups, ecological processes, physical and chemical processes, and pests etc) in an unweighted and low-bias framework of analysis. In this way priorities for further action can be derived unweighted across species, habitat types, and processes etc, without an undue bias created by, for example, those parameters for which there may be large quantities of data, or factors which may be very important for one jurisdiction but no others across the region.

In many ways, this methodology helps to address issues of a lack of efficiency and effectiveness in management and conservation of biodiversity in a region. Choosing intervention strategies that are selected from narrowly-based priority-assessment systems are likely to be both inefficient and ineffective, even if they achieve their objectives. This is the equivalent problem to the issue in business and economics of choosing the wrong portfolio of projects. In natural resources management, the problem has been famously expressed as 'doing the thing right, rather than the right thing' by Carl Walters. In biodiversity conservation and management, 'working with what we know well' is a similar framework for delivering inefficiency and ineffectiveness.

A. Identifying high value components of biodiversity for improved protection

This example explores the region-wide identification of biodiversity parameters that are considered to be in Good or Very Good condition. These may, for example, be considered for further detailed investigation for development of a protected areas system for the region, or other appropriate management initiatives (such as reducing specific forms or fishing, or sediment/nutrient inputs) to reduce pressures and thereby provide high levels of protection to ensure secure maintenance of the existing high quality areas/parameters.

For this purpose, a subset of the workshop dataset was developed, filtered to contain only condition and trend, and also to only include data that was assigned with either medium or high levels of confidence at the workshop. All data on confidence or pressures was therefore discarded during this filtering process. This subset comprised 81 parameters, with data for 6 indicators: condition and trend in the Best10%, Most and Worst10% of places. The classification of these 81 parameters is shown are Figure A1, and the associated heat map is presented in Figure A2.

The cluster diagram reveals 4 groups of parameters, and 6 parameters that each form their own group. This pattern has not been influenced the experts confidence in their assignment of scores/grades or by the distribution of pressures across the region (other than the initial process of choosing the data subset for analysis).

The primary pattern in the classification is shown by the divergence of the parameters in Groups 3 (8 parameters) and 4 (11 parameters), and 6 individual parameters (16, 39, 42, 51, 60 and 79) from all the other parameters.

Group 4 parameters are distinguished from the other groups because none of these parameters were assigned condition scores or trends for either Best10% or Worst10%.

Group 3 parameters are distinguished because they form a group with the highest condition score of any group for both the Worst10% (average score = 4) and Most (average score = 6.9) (of the all the groups containing more than a single parameter). Group 3 parameters generally were stable or in decline, with only one parameter considered to be increasing in condition.

Overall, Group 3 and the 6 individual parameters could be considered as containing the biodiversity parameters in the best condition across most of the region, but also containing a number of parameters in decline, as well as demonstrating some of the worst conditions in the region (in the Worst10%). The data from this set of parameters are shown in Table A1.

The value of this form of analysis is that, within a single analytical framework, the analysis has identified a small number of parameters across a range of habitats, species, and processes that meet an identical set of prioritisation criteria. In this hypothetical case, the analysis has focused on a mix of biodiversity and ecosystem health parameters across the region that are both in best condition and are either stable or in decline, indicating they may be under high levels of stress. Parameters chosen from this group could therefore be considered as potential targets for successful early intervention to avoid further region-wide decline of important aspects of the region's biodiversity.

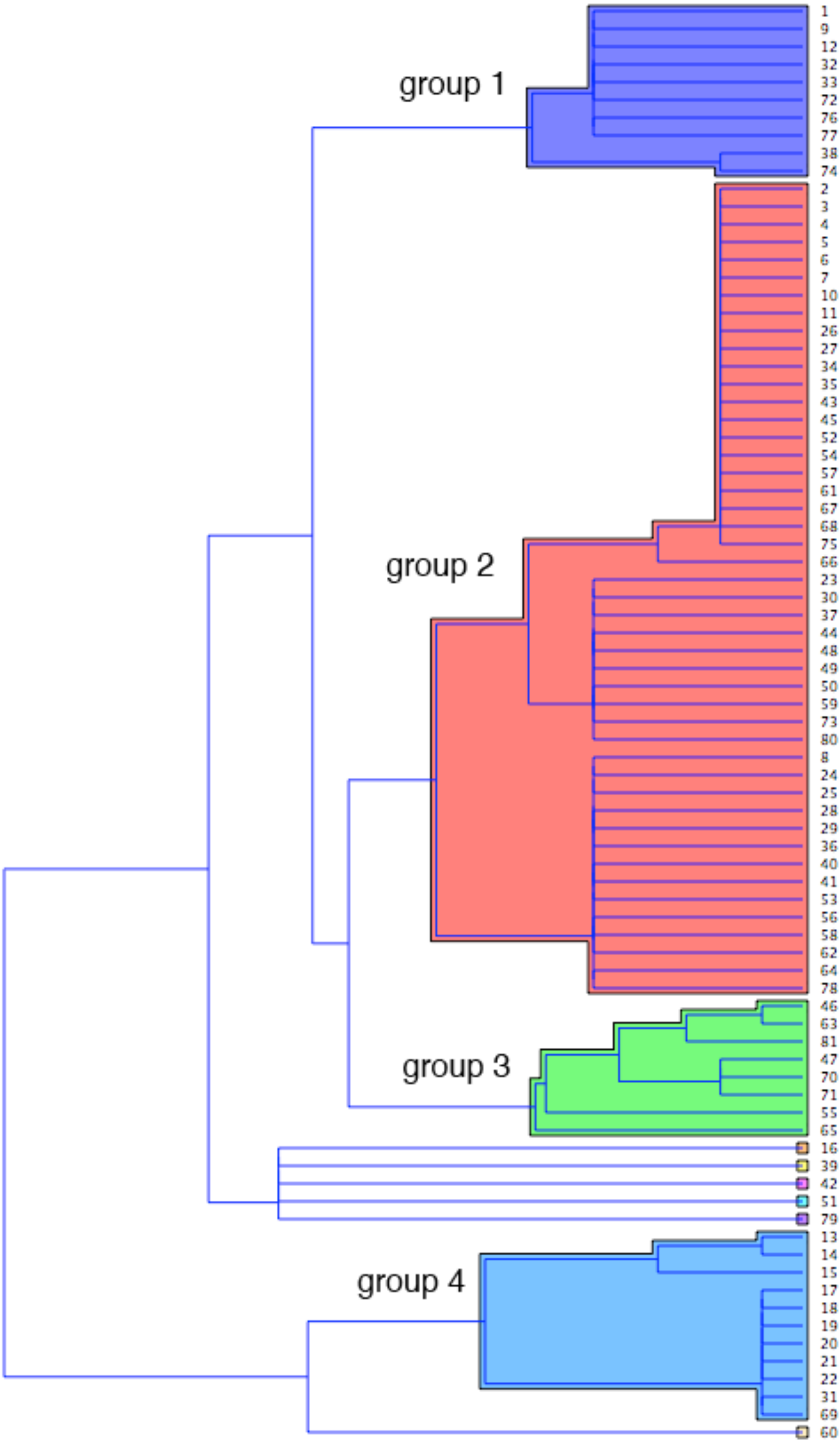


Figure A1: Classification of the data on condition and trends of 81 parameters of biodiversity and ecosystem health that were assigned with either Medium or High confidence (does not include data on pressures or confidence).

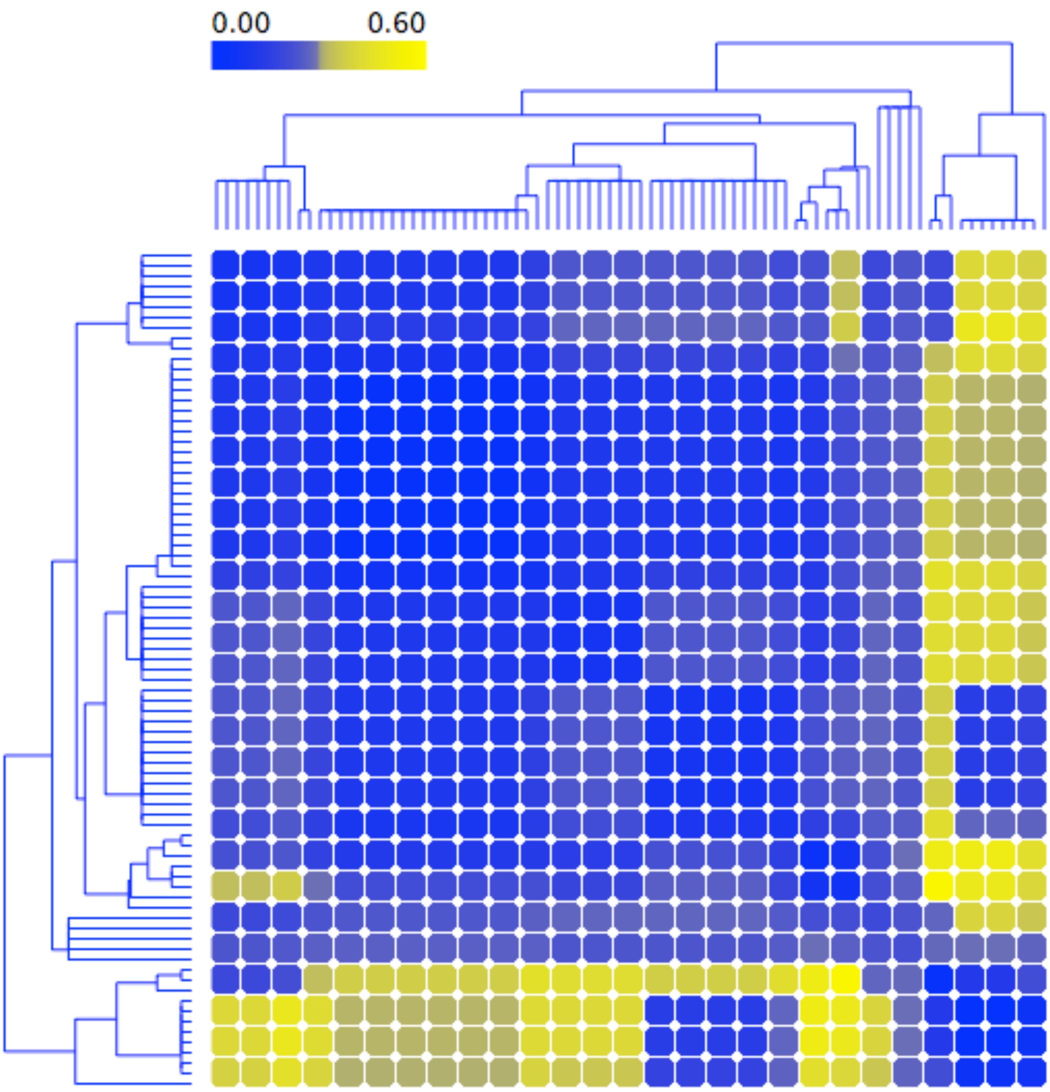


Figure A2: Heat map from the classification shown in Figure A1. The greatest divergences (yellow coloured cells) are demonstrated by parameters comprising Groups 3 and 4, and 6 individual parameters.

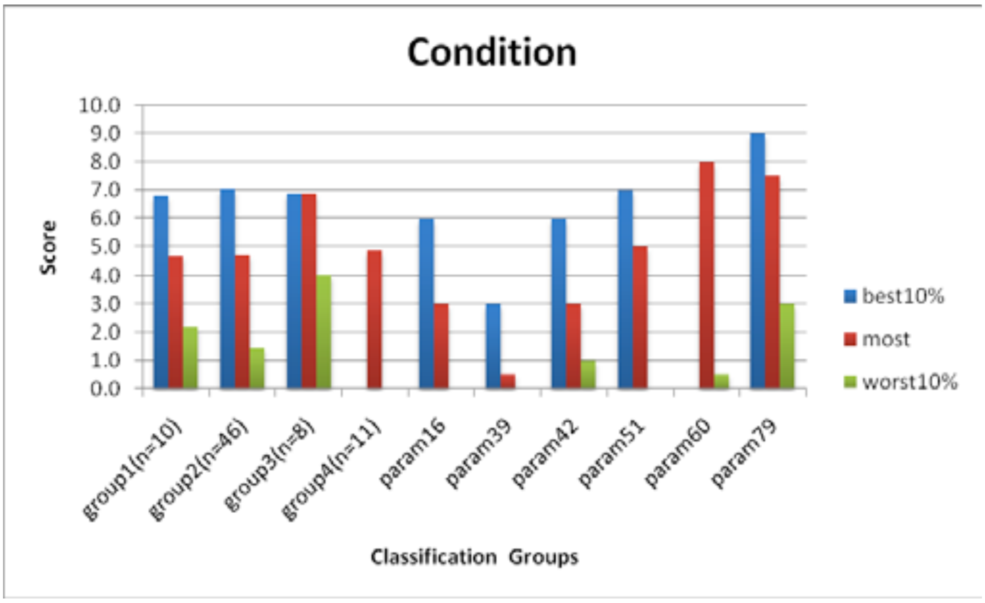


Figure A3: Condition of the parameters for condition and ecosystem health that were assigned with either Medium or High confidence. Parameters with data assigned at Low confidence, and data on pressures and confidence are not included in the assessment shown here. The parameters in Group 3 have high average scores for the Best10%, and have the highest average score for Most and the Worst10%. In the Worst10% of places, Group 3 is the only group classified as an average Poor condition (score>2.5); all the remaining groups (except Parameter 79) are in Very Poor condition in the Worst10% of places.

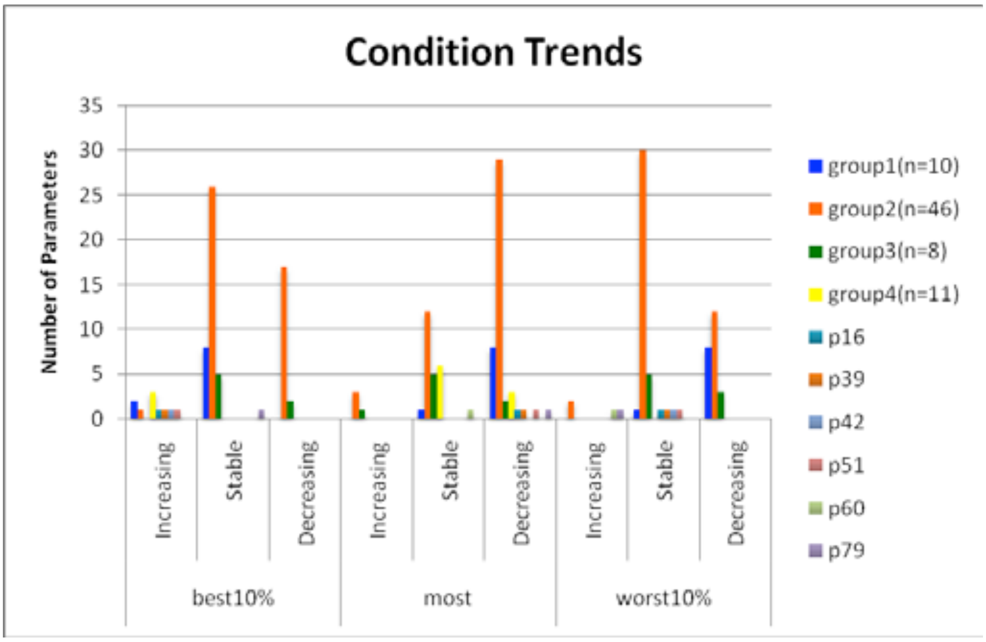


Figure A4: The trends in parameters from each group in the classification. A majority of parameters in Groups 2, 3 and 4 were either Stable or Decreasing across the region.

#	Parameter	Group	Condition (Most)	Trend (Most)
46	seabed inner shelf (0-50m)	Habitats	4	S
47	seabed outer shelf (50-200m)	Habitats	5	D
55	Mekong Delta	Habitats	7	I
63	sea level change	Chemical and physical processes	6	D
65	nutrient supply and cycling: ocean-based	Chemical and physical processes	7	S
70	low oxygen-dead zones	Chemical and physical processes	8	S
71	groundwater salinity	Chemical and physical processes	9	S
81	frequency, abundance distribution of biofouling	Pests, diseases etc	9	S
16	river otters	Species	3	D
39	giant clam (Tridacna spp)	Species	0.5	D
42	coastal lagoons	Habitats	3	
51	seagrass beds	Habitats	5	D
79	frequency, abundance and distribution of red tides, leading to anoxia and fish-kills	Pests, diseases etc	7.5	D
60	sediment transportation (shoreline)	Chemical and physical processes	8	S

Table A1: Parameter membership of classification Group 3, and the 6 individual parameters from the classification (full data for these parameters are shown in Annex 5).

B. Highly degraded region-scale biodiversity for restoration/recovery

This analysis used the same dataset as above: 81 parameters with condition and trend data assigned at Medium or High confidence level; data on pressures or confidence was excluded.

The parameters of Group 2 (46) and 5 of the 6 individual parameters were assigned the lowest scores in the Worst10% of places (Figure A3). Many of these scores (17 of the 51 parameters) were assigned 0, and the overall average score across these parameters in the Worst 10% of places was extremely low (Very Poor; 1.3).

From this set of 51 parameters, 34 were assessed as stable, 12 were considered to be in continuing decline, and only 3 were considered to be improving in condition (sediment inputs from rivers; sediment transportation – shoreline; the frequency, abundance, distribution of algal blooms producing toxins).

From this set of 51 parameters, 38 parameters demonstrate both poorest condition in the Worst10% of places and are either stable (many are in such poor condition that there is no option for further decline) or are continuing to decline. These might be considered as amongst the most urgent targets for restoration/recovery at the region-scale. The 38 parameters include 15 species or species groups, 13 habitats, 9 ecological processes, and 1 physical/chemical process (Table A2).

The processes, species groups and habitats represented in this group are amongst the most regionally degraded components of biodiversity assessed at the workshop. Where the drivers responsible for their current condition are broadly understood (such as heavy fishing pressure, nutrient pollution, local and oceanic pollution by plastics), each will have a spatial distribution within the region that could underpin a strategic approach to restoration activities. The drivers for the ecological processes are probably largely indirect, relating to a broad range of pressures and mediated by impacts on various species and habitat groups interacting with physical and chemical drivers, whereas the drivers for degradation of species groups are likely to be proximal and more easily identified for corrective action at a regional scale. Even so, both types of issues would require focussed review and analysis as part of the strategic development of region-wide restoration programmes.

The form of analysis presented here reduces the complexity and diversity of biodiversity parameters that need to be critically assessed, and provides a basis for subsequent focused development of efficient programmes of activity at the region-scale. These could involve, for example:

- focused development of the available information base about a selected set of parameters;
- development of better cause-effect models linking pressures and their dynamics to impacts on the biodiversity parameters; or
- where the causes and spatial structure is already understood to an adequate level, then direct intervention programmes may be designed to deliver remediation/restoration of the identified parameters.

#	Parameter	Group	Condition (Worst 10%)	Trend (Worst 10%)
2	biological migration, flyways	Ecological process	1	D
3	recruitment, settlement	Ecological process	1	D
4	genome structures, genetic adaptation	Ecological process	1	D
5	nesting, roosting, spawning and nursery sites	Ecological process	1	D
6	feeding grounds	Ecological process	1	D
7	trophic structures and relationships	Ecological process	1	D
10	reef building	Ecological process	0.5	D
11	predation	Ecological process	0.5	D
26	shelf & slope squid spp.	Species	1.5	
27	inner shelf - crustaceans	Species	1	D
34	seagrass species	Species	0	S
35	algae species	Species	0	S
45	coral reefs not contiguous with shoreline including atolls	Habitats	0.5	D
52	algal beds	Habitats	0	S
57	Jakarta Bay	Habitats	1	
67	toxins, pesticides, herbicides	Physical, chemical processes	2	S
8	water column, pelagic productivity	Ecological process	1	S
23	small pelagics—shelf (0-200m)	Species	2	D
24	inner-shelf reef fish assemblages (0-50m)	Species	0	S

25	grazers/herbivorous fish assemblages of coral reefs	Species	0	S
28	shoreline and intertidal soft sediment invertebrate spp.	Species	0	S
29	shoreline and intertidal rocky shore invertebrate spp.	Species	0	S
30	hard coral species	Species	0	S
36	dune, , foreshore, wetland species	Species	0	S
37	Holothurians	Species	0	S
40	Groupers	Species	0	S
41	estuaries and deltas	Habitats	0.5	S
44	coral reefs occurring along coasts and islands (intertidal & subtidal)	Habitats	0	S
48	water column shoreline (0-20m)	Habitats	1	S
49	water column inner shelf (20-50m)	Habitats	2	S
50	mangroves	Habitats	0	S
53	intertidal mudflats	Habitats	2	S
56	Pearl Estuary	Habitats	1	S
58	Sihanouvkville Bay	Habitats	0	S
16	river otters	Species	0	S
39	giant clam (Tridacna spp)	Species	0	S
42	coastal lagoons	Habitats	1	S
51	seagrass beds	Habitats	0	S

Table A2: Parameters from Group 2 and the 6 individual classification parameters that are in Very Poor condition (<2.5) in the Worst10% of the region, and are either Stable or in Decline.

Annex 5: Worksheets Completed by the Experts

This is the summary format. A number of these worksheets have been edited for consistency with the workshop methodology, without influencing the scoring/grading. The comments columns have been removed from the matrices shown here, for presentation purposes.

SCS-P1 Habitat Quality for Species

Habitat/ Group	Parameter/ Metric	**Condition** *(0-10, quality relative to condition of reference point)*				**Trend in Condition** *(Improving, Stable, Declining)*			
		Best 10% places	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*	**Best 10% places**	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*
Benthic systems	estuaries and deltas	6	3.5	0.5	H	S	D	S	H
	small gulfs and bays	7	5	2	M				
	coastal lagoons	6	3	1	H	I	?	S	M
	beaches (sandy beaches)	8	6	3	M	D	D	D	M
	Rocky coasts, including karst and non-coral reefs fringing coasts and islands (intertidal and subtidal)	8	6	6	M	S	S	S	L
	coral reefs occuring along coasts and islands (intertidal and subtidal)	7	4	0	H	D	D	S	H
	coral reefs not contiguous with shoreline including atolls	7	5	0.5	H	D	D	D	H
	seabed inner shelf (0-50m)	4	4	0	M	S	S	S	H
	seabed outer shelf (50-200m)	5	5	0	M	D	D	S	H
	seabed shelf break and upper slope	9	8	7	L				
	slope (700-1500m)								
	seabed abyss (>1500m)								
Water column systems	water column shoreline (0-20m)	7	4	1	H	D	D	S	H
	water column inner shelf (20-50m)	8	5	2	M	D	D	S	M

	water column outer shelf (50-200m)	8	7	7					
	water column offshore (>200m)	8	7	7					
Biological systems	mangroves	7	5	0	H	I	I	S	H
	seagrass beds	7	5	0	M	I	D	S	M
	algal beds	8	6	0	M	S	S	S	M
	deep coral reefs (30m)								
	cold water corals and sponges (>30m)								
	bryozoan reefs								
	intertidal mudflats	8	6	2	M	S	D	S	M
Structural systems	canyons and shelf-break								
	seamounts (>1000m rise from seafloor)								
	large gulfs, large bays								
	offshore banks, shoals, islands	8	6	3	M	S	S	S	M
	major river deltas/wetlands								
	karst systems								
Special features, iconic habitats/ systems	Ha Long Bay WH		7						
	Bight of Bangkok								
	Mekong Delta	7	7	2	H	S	I	S	H
	Pearl Estuary	7	4	1	H	S	I	S	H
	Jakarta Bay	7	6	1	H				
	Sihanouvkville Bay	7	6	0	H	S	I	S	H
	Lingayen Gulf								
	Tubbataha Reef WHS								
	Palawan Biosphere Reserve								
	Verde Island Passage								
	Batanes Islands								
	NIPAS MPA								
	Natuna Archipelago								
	Upper Gulf of Thailand								
	Lower Gulf of Thailand								

SCS-P2 Species, Species Groups

Species/ Group	Parameter/ Metric	**Condition** *(0-10, quality relative to condition of reference point)*				**Trend in Condition** *(Improving, Stable, Declining)*			
		Best 10% places	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*	**Best 10% places**	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*
Mammals	Whales - baleen		8		H	I			M
	Whales - toothed		8		H	I			M
	dolphins, porpoises		6		M	I	S		M
	river otters	6	3	0	H	I	D	S	M
	dugongs		1		H		D		H
Fish	sharks and rays –		2		H		S		H
	Great white shark								
	Whale shark		4.5		M		S		L
	tuna and tuna-like fish		3		H		D		M
	Inner shelf (0-50m) demersal large fish assemblages		2		H		S		H
	Inner shelf (0-50m) demersal small fish assemblages		3.5		H		S		H
	outer shelf (50-200m) demersal & benthopelagic fish assemblages		3		M		S		H
	slope - demersal fish assemblages (>200m)								
	meso-pelagic fish assemblages		6		L		?		0
	small pelagics - shelf (0-200m)	6	4	2	H	S	S	D	M
	Inner-shelf reef fish assemblages (0-50m)	5	3	0	H	S	D	S	M
Invertebrates									
	grazers/herbivores fish assembalges of coral reefs	5	3	0	H	S	D	S	M
	shelf & slope squid spp.	6	4	1.5	H				M
	Inner shelf - crustaceans	4	2	1	H	D	D	D	H
	Inner shelf – other invertebrate spp.	3	2	1	H	S	?	?	L

	shoreline and intertidal soft sediment invertebrate spp.	4.5	4	0	M	S	D	S	M
	shoreline and intertidal rocky shore invertebrate spp.	5.5	4	0	M	S	D	S	M
	benthic filter feeders of soft and hard subtrata, e.g. sponges, molluscs, polychaetes,								
	hard coral species	7	3.5	0	H	D	D	S	H
Birds	seabirds - resident		8		H		S		H
	migratory seabirds/waders								
Reptiles	turtles	5	3	1	H	S	D	D	H
	seasnakes	6	5	3	L		D		L
	crocodiles								
Plants	mangrove species	8	4	0	H	I	S	S	H
	seagrass species	8	4	0	H	S	S	S	H
	algae species	8	4	0	M	S	S	S	M
Additional unique key species, icons, specially protected species, etc									
	dune, , foreshore, wetland species	6	3	0	M	S	D	S	M
	Seahorses and pipefish								
	Holothurians	4	2	0	H	D	D	S	H
	Triton gastropods (*Charonia spp*)	0.5	0	0	H	S			H
	Giant clam (*Tridacna spp*)	3	0.5	0	H	I	D	S	H
	Coelacanth								
	Groupers	4	3	0	H	S	D	S	H
	Crown of Thorns starfish								
	Lobsters (spiny)								
	Butterfly fish								

SCS-P3 Ecological Processes - supporting biodiversity

Type	Parameter/ Metric	**Condition** *(0-10, quality relative to condition of reference point)*				**Trend in Condition** *(Improving, Stable, Declining)*			
		Best 10% places	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*	**Best 10% places**	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*
Connectivity	Spatial/physical disjunctions	8	6	1	H	S	D	D	H
	Biological migration, flyways	7	4.5	1	H	D	D	D	H
	Recruitment, settlement	8	4.5	1	M	D	D	D	H
	Genome structures, genetic adaptation	6	5	1	M	D	D	D	H
	Nesting, roosting, spawning and nursery sites	8	5	1	H	D	D	D	H
	Feeding grounds	8	4.5	1	H	D	D	D	H
Productivity	Trophic structures and relationships	7.5	4.5	1	H	D	D	D	H
	Water column, pelagic productivity	9	5.5	1	H	S	D	S	H
	Benthic productivity-inshore	6	4	0.5	H	S	D	D	H
	Benthic productivity-offshore	8	7	4	L	S	S	D	L
	Reef building	7	4	0.5	M	D	D	D	M
	Symbiosis: fish, corals, molluscs								
	Predation	6	3	0.5	H	D	D	D	
	Herbivory	6	4	1	M	I	D	D	M
	Filter feeding								
	Microbial processes								
Additional key processes	Epiphytism								
	Succession								
	Turnover								
	Source-Sink relationships								

SCS-P4 Physical and Chemical Processes - supporting biodiversity

Type	Parameter/ Metric	**Condition** *(0-10, quality relative to condition of reference point)*				**Trend in Condition** *(Improving, Stable, Declining)*			
		Best 10% places	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*	**Best 10% places**	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*
Transport mechanisms	Ocean currents, structure and dynamics		9.9		H				
	Storms, cyclones, wind patterns		9				D		M
Sediment regime	Sediment inputs	8	6	4	H	S	S	I	H
	Sediment transportation		8	0.5	M		S	I	H
	Coastal/shoreline erosion	9	6	3	H	S	S	S	H
Light regime	Inshore water turbidity, transparency and colour	8.5	7	3	H	S	D	S	H
Temperature regime	Sea temperature, including SST		8		L		D		
Sea level	Sea level change	6	6	4	H	D	D	D	H
Nutrient supply, cycling	Nutrient supply and cycling: land-based (land sourced nutrients supplied by river or stream)	8	4	3.5	H	S	D	S	H
	Nutrient supply and cycling: ocean-based	7	7	6	M		S	S	M
	Freshwater inflow, surface and groundwater runoff	7	6	6	H	S	S	S	H
Components	Toxins, pesticides, herbicides	7	4	2	H	S	S	S	H
	Dumped wastes	8	7	3	H	S	S	S	H
	Radionuclides								
	Ocean acidity								
	Ocean salinity		9		H		D		H
	Low oxygen-dead zones	8	8	4	H	S	S	D	H
	Groundwater salinity	9	9	7	H	S	S	D	H

	Coastal land salinity/acidity	8	7	3	H	S	D	D	H
	Seaweed/seagrass wracks								
	Marine debris wracks			6		D	D	D	H
Physical Features	major currents								
	major upwellings								
	oceanic fronts								
Air–sea Interactions	air-sea nutrient fluxes, air-sea gas exchange								
	air-sea chemical, pollutant inputs								
	atmospheric forcing via rainfall, wind, air temperature								
	extreme climate events								

SCS-P5 Pests, invasive species, diseases, algal blooms

Type	Parameter/ Metric	**Condition** *(0-10, quality relative to condition of reference point)*				**Trend in Condition** *(Improving, Stable, Declining)*			
		Best 10% places	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*	**Best 10% places**	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*
Pests (declared)	Number and abundance of declared pest species								
Invasive Species	Recent Report on the Current Status of Marine Non-indigenous	9	7.5	5	M	D	D	S	M
	Frequency, abundance distribution of jellyfish blooms	10	9	9	H	S	D	D	M
	Frequency and abundance of *Acanthaster planci* (Crown of Thorns)	7.5	5	3	M	S	S	S	M
Diseases	Number and extent of outbreaks of viral, bacterial, and fungal diseases	8	5	3	H	S	D	D	M
	Number and extent of outbreaks of parasitic infestations								
	Number and extent of fish-kills	8	5	3	M	S	D	D	M
Algal Blooms	Frequency, abundance distribution of algal blooms	9	7.5	3	M	S	D	S	H
	Frequency, abundance and distribution of red tides, leading to anoxia and fish-kills	9	7.5	3	H	S	D	I	H
	Frequency, abundance distribution of algal blooms producing toxins	9	7.5	3	H	S	S	I	H
Biofouling	Frequency, abundance distribution of biofouling	9	9	9	H	S	S	S	H

SCS-P6 Pressures and Threats to biodiversity, ecosystem health, social, economic assets/values

Type	**Size/Importance of the Pressure/Impact** *(0-10, size, extent, importance relative to benchmark; 0=major impact on the assets/values, 10=negligible impact on the assets/values)*				**Trend in Pressure/Impact I, S or D** *(pressure is abating =Improving conditions; pressure remains steady = Stable conditions; pressure is increasing =Declining conditions)*			
	Best 10% places	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*	**Best 10% places**	**Most places**	**Worst 10% places**	**Confid-ence** *(high, med, low)*
Climate change and variability		5	5	M		S		M
Extreme climate events								
Coastal urban development	8	6	0.5	H	D	D	D	H
River discharges	7	5	3.5	H	D	D	S	H
Coastal Wetland Conversion	9	4	2	H	D	D	D	H
Land Reclamation	9	8	7	H	S	D	D	H
Port facilities								
Oil and gas exploration and production								
Fishing	6	3.5	1.5	M	S	S	D	M
Aquaculture, including sea cages and on-shore ponds	9	5	1	M	D	D	S	H
Eutrophication from coastal sources	9	6	2	H	S	D	D	M
Tourism islands and developments								
Marine Debris								
IUU fishing/ harvesting								
Power generation								
Desalination facilities								
Foreshore protection with hard substrates								
Mining and associated infrastructure								

GRID-Arendal
Phone: +47 47 64 45 55
Fax: +47 37 03 50 50
E-mail: grid@grida.no
Web: www.grida.no

Visiting address:
Teaterplassen 3
N-4836 Arendal
Norway

Mailing address:
GRID-Arendal
Postboks 183
N-4802 Arendal
Norway