CONVENTION ON WETLANDS (Ramsar, Iran, 1971)

11th Meeting of the Scientific and Technical Review Panel
Gland, Switzerland, 8-11 April 2003

DOC. STRP11-10
Addendum 1

Agenda item 6.1 i)

Draft Guidelines for methods, including indicators, for monitoring and the rapid assessment of wetland biodiversity – marine and coastal

1. As indicated in DOC. STRP11-10, a paper concerning methods and guidance for rapid assessment of marine and coastal biological diversity is in preparation by the CBD secretariat with input from the Ramsar Bureau.

2. A working draft of this paper was made available as an Information Paper to CBD's SBSTTA8 meeting in mid-March 2003 and is attached to this note. This provides further background material for the high priority task requested of the Panel for 2003-2005 concerning development of practical methods, including indicators, for monitoring wetlands and for the rapid assessment of wetland biodiversity, including both inland waters and coastal and marine systems.

3. The Panel should note that:

   i) this draft is undergoing further expert consultation and that a final draft will be prepared for consideration by CBD's SBSTTA9 meeting in November 2003; and

   ii) the first part is this draft paper is derived from, and closely resembles, the equivalent parts of the paper on inland waters rapid assessment provided in DOC. STRP11-10.

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Item 5.2 of the provisional agenda*

MARINE AND COASTAL BIODIVERSITY: REVIEW, FURTHER ELABORATION AND REFINEMENT OF THE PROGRAMME OF WORK

Rapid assessment of marine and coastal biological diversity: a progress report on the development of methods and guidance

Note by the Executive Secretary

I. INTRODUCTION

1. In paragraph 25 of its decision V/20, the Conference of the Parties recognized that there is a need to improve the quality of the scientific, technical and technological advice provided to it. In paragraph 29(a) of the same decision, the Conference of the Parties requested SBSTTA to identify, and where needed, further develop procedures and methods to undertake or participate in scientific assessments, or make use of existing ones. In response to this, SBSTTA, at its sixth meeting adopted recommendation VI/5, on the development of methodologies and identification of pilot studies for scientific assessments, including those relating to marine and coastal biological diversity.

2. In response to recommendation VI/5, paragraph 6(c), the Executive Secretary prepared, for the consideration of the seventh meeting of SBSTTA, a project brief concerning the development of rapid assessment methods for marine and coastal biological diversity, in particular ecosystem evaluation and assessment (UNEP/CBD/SBSTTA/7/3, annex II, section A 2). The project brief outlined a procedure, which will provide guidance on the use of existing

* UNEP/CBD/SBSTTA/8/1.

rapid assessment methods, including the suitability of particular methods for a given purpose, as well as the required resources, such as time, financial considerations, institutional and human resources, for undertaking a particular assessment. This document provides a progress report, including a draft of the guidance under preparation.

3. The guidance being created uses as its basis the guidelines developed during the Expert Meeting on Methods and Guidelines for the Rapid Assessment of Biological Diversity of Inland Water Ecosystems, which was held in Montreal from 2 to 4 December 2002. The draft guidance, which is contained in this document, is currently under review by a Liaison Group. This group, which is operating electronically through a listserv and a restricted web site, has representatives from the following organizations or assessments: The Global International Waters Assessment (GIWA); Marine Rapid Assessment Programme of Conservation International; Atlantic and Gulf Rapid Reef Assessment (AGRRA); Ramsar Convention; UNEP-WCMC; Northwest Hawaiian Islands Rapid Reef Assessment (NOW-RAMP); The Intergovernmental Oceanographic Commission (IOC) of UNESCO; The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA); Land-Ocean Interactions in the Coastal Zone (LOICZ); Reef Check; Reefs at Risk of the World Resources Institute; Coral Reef Degradation in the Indian Ocean (CORDIO); Arctic Assessment and Monitoring Programme; FAO Fisheries Division; the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention); WWF; IUCN; Global Marine Assessment (GMA); Caribbean Environment Programme; South Pacific Environment Programme; the SPA protocol of the Mediterranean Action Plan; Eastern African Regional Seas Programme; Regional Coordinating Unit for East Asian Seas; and Regional Organization for the Protection of the Marine Environment (ROPME). The guidance will be finalized for the consideration of SBSTTA at its ninth meeting.

4. The draft document is presented here for the information of SBSTTA. Recognizing that the underlying principles for rapid assessment are the same for both marine and freshwater environments, this document does not attempt to duplicate the information contained in Annex III to document UNEP/CBD/SBSTTA/8/INF/5, but rather provides a short summary of the main points of that document, followed by a detailed elaboration, in the annexes to this document, of methods for the rapid assessment of marine and coastal biological diversity. For a more in-depth coverage of theoretical and methodological aspects of rapid assessment in general, the reader is therefore referred to the guidelines contained in annex III to the report of the Expert Meeting on Methods and Guidelines for the Rapid Assessment of Biological Diversity of Inland Water Ecosystems (UNEP/CBD/SBSTTA/8/INF/5).

II. RAPID ASSESSMENT – DEFINITIONS AND ISSUES

5. For the purpose of this document, rapid assessment can be defined as: "a synoptic assessment, which is often undertaken as a matter of urgency, in the shortest timeframe possible to produce reliable and applicable results".

6. This definition was originally developed by the Expert Meeting on Methods and Guidelines for the Rapid Assessment of Biological Diversity of Inland Water Ecosystems. It was noted that rapid assessment methods are not generally designed to take into account temporal variance, such as seasonality, in ecosystems. However, some rapid assessment methods can be (and are being) used in repeat surveys as elements of an integrated monitoring programme to address such temporal variance.

7. Rapid assessments can range from desk studies, expert group meetings and workshops to field surveys. They can include compiling existing expert knowledge and information, including traditional knowledge and information, and field survey methods.

8. Rapid assessments can be undertaken at a wide range of spatial scales. In general a large-scale rapid assessment will consist of the application of a standard method to a larger number of localities or sampling stations.

9. Assessments can be divided into three stages: design/preparation, implementation and reporting. "Rapid" should be applied to each of these stages. Rapid assessments provide the necessary results in the shortest practicable time although preparatory and planning work prior to the survey may be time-consuming. Under some circumstances (for example when taking into account seasonality) there may be a delay between the decision to undertake the assessment and the carrying out of the assessment. In other cases (for example in cases of disturbances and disasters) the assessment will be undertaken as a matter of urgency, and preparatory time should be kept to a minimum.

III. A CONCEPTUAL FRAMEWORK FOR RAPID ASSESSMENT

10. A conceptual framework for rapid assessment was developed by the Expert Meeting on Methods and Guidelines for the Rapid Assessment of Biological Diversity of Inland Water Ecosystems. This framework, which was derived from the Ramsar Framework on Wetland Inventory, is general enough to also be applicable in the marine environment.

11. The process of applying the conceptual framework is summarized in figure 1. Steps in the conceptual framework, and guidance for their application are listed in table 2.

Figure 1. Summary of key steps in applying the conceptual framework for rapid assessment (see Table 2 for further details)

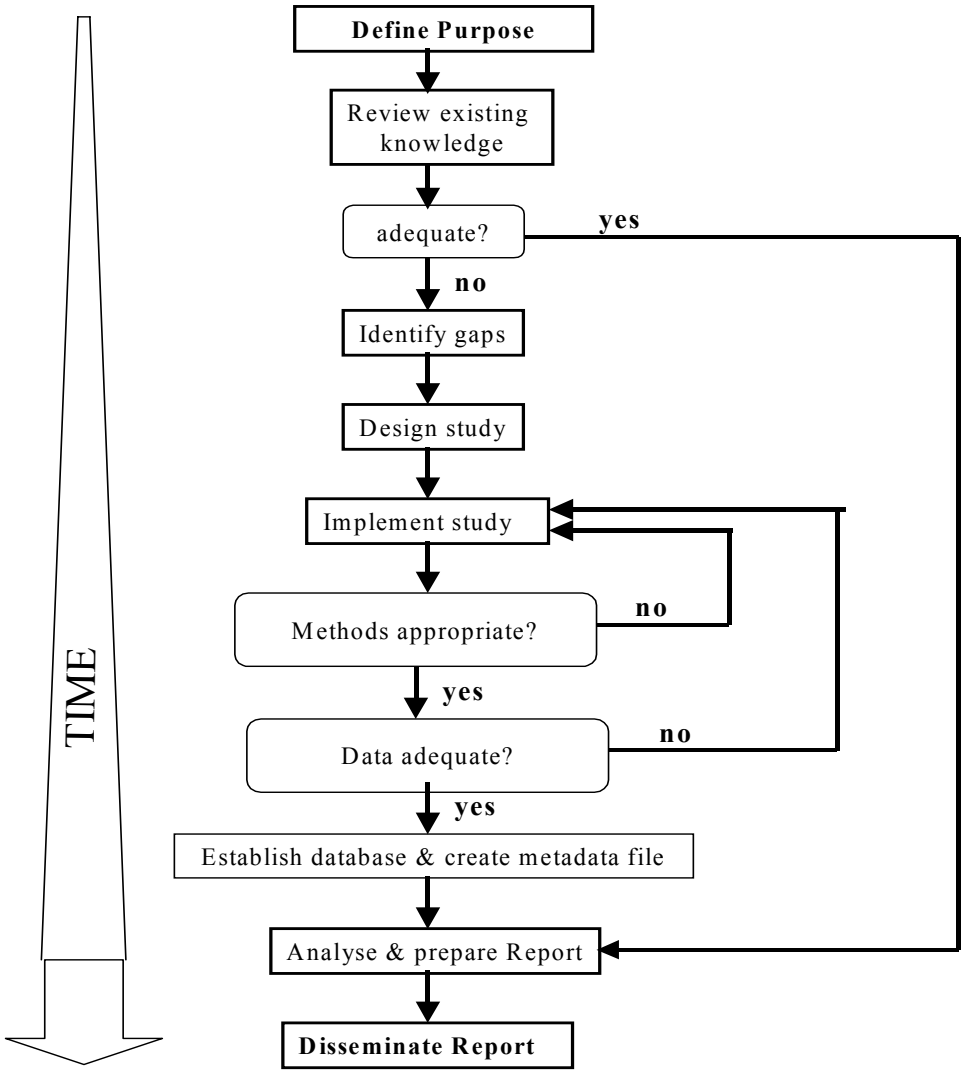

Table 1. Conceptual framework for designing and implementing a rapid assessment of marine and coastal biodiversity

Step	Guidance
1. State the purpose and objective	State the reason(s) for undertaking the rapid assessment: why the information is required, and by whom it is required.
a. Determine scale and resolution	Determine the scale and resolution required to achieve the purpose and objective.
b. Define a core or minimum data set	Identify the core, or minimum, data set sufficient to describe the location and size of the site(s) and any special features. This can be complemented by additional information on factors affecting the ecological character of the site(s) and other management issues, if required.
2. **Review existing knowledge and information – id gaps** (if done, write report, if not, design study)	Review available information sources and peoples' knowledge (including scientists, stakeholders, and local and indigenous communities), using desk studies, workshops etc, so as to determine the extent of knowledge and information available for marine and coastal biodiversity in the region being considered. It is important to include identification of not just local data and information but also other relevant national and international sources, which can provide supplementary data and information to underpin the rapid assessment.
3. **Study design**	
a. **Review existing assessment methods, and choose appropriate method**	Review available methods and seek expert technical advice as needed, to choose the methods that can supply the required information. **Apply the rapid assessment decision tree and choose appropriate field survey methods.**
b. Establish a habitat classification system where needed	Choose a habitat classification that suits the purpose of the assessment, since there is no single classification that has been globally accepted.
c. Establish a time schedule	Establish a time schedule for: a) planning the assessment; b) collecting, processing and interpreting the data collected; and c) reporting the results.
d. Establish the level of resources required, assess the feasibility & cost effectiveness that are required	Establish the extent and reliability of the resources available for the assessment. If necessary make contingency plans to ensure that data are not lost due to insufficiency of resources. Assess whether or not the program, including reporting of the results, can be undertaken within the current institutional, financial and staff situation. Determine if the costs of data acquisition and analysis are within budget and that a budget is available for the program to be completed. [Where appropriate, plan a regular review of the program.]
e. Establish a data management system and a specimen curation system	Establish clear protocols for collecting, recording and storing data, including archiving in electronic or hardcopy formats. Ensure adequate specimen curation. This should enable future users to determine the source of the data, and its accuracy and reliability, and to access reference collections. At this stage it is also necessary to identify suitable data analysis

Step	Guidance
	methods. All data analysis should be done by rigorous and tested methods and all information documented. The data management system should support, rather than constrain, the data analysis. A meta-database should be used to: a) record information about the inventory datasets; and b) outline details of data custodianship and access by other users. Use existing international standards.
f. **Establish a reporting procedure**	Establish a procedure for interpreting and reporting all results in a timely and cost effective manner. The reporting should be succinct and concise, indicate whether or not the objective has been achieved, and contain recommendations for biodiversity management action, including whether further data or information is required.
g. **Establish a review and evaluation process**	Establish a formal and open review process to ensure the effectiveness of all procedures, including reporting and, when required, supply information to adjust the assessment process.
4. Perform study and include continuous assessment of methodology (go back and revise design if needed)	Undertake study method. Test and adjust the method and specialist equipment being used, assess the training needs for staff involved, and confirm the means of collating, collecting, entering, analysing and interpreting the data. In particular, ensure that any remote sensing can be supported by appropriate "ground-truth" survey.
5. Data assessment and reporting (was purpose of the study achieved? If not, go back to step 3)	Establish a formal and open review process to ensure the effectiveness of all procedures, including reporting and, when required, supply information to adjust or even terminate the program. Results should be provided in appropriate styles and level of detail to, *inter alia,* local authorities, local communities and other stakeholders, local and national decision-makers, donors and the scientific community.

II. THE RAPID ASSESSMENT DECISION TREE

12. The rapid assessment decision tree is a schematic guide to a number of available methods used for rapid assessment of marine and coastal biological diversity. The decision three is meant to enable selection of appropriate biodiversity assessment methods, based on a structured framework of selection criteria. The tree begins with the most basic and broad elements of an assessment, and advances through progressively more selective criteria. Eventually a general framework of the necessary assessment should emerge, taking the amalgamated form defined by its purpose, output information, available resources, and scope. The idea is to meld informational parameters, like output and purpose, with logistical parameters such as time frame, available funding, and geographical scope, in order to present a realistic assessment model and determine what methods are available for its implementation.

13. The following paragraphs provide guidance on the application of the decision tree in the context of rapid assessment of marine and coastal biological diversity.

14. Defining the purpose is the first step of a biodiversity assessment. The decision tree (figure 2) provides three general purposes for an assessment, which correspond to five specific purposes, and will determine the assessment type. The five specific assessment types used in the decision tree are: ***Inventory Assessment, Specific-species Assessment, Change Assessment, Indicator Assessment, Economic Resource Assessment***. These are organized numerically and coordinated with their output information presented in Tables 3-7 in Annex 1. The assessment types are explained below. For additional detail, please refer to the report of the Expert Meeting on Methods and Guidelines for the Rapid Assessment of Biological Diversity of Inland Water Ecosystems.

15. *Inventory assessments* focus on overall biological diversity rather than extensive or detailed information about specific taxa or habitats. The goal is to gather as much information as possible about the ecosystem through extensive and, as much as possible, comprehensive sampling of its biological constituents. An inventory assessment provides initial information about a defined area of interest. The output information could be useful in prioritizing species or areas of particular concern for conservation, identifying new species, and developing a broad view of the overall biodiversity of an area. Case study I in Annex IV provides an example of an inventory assessment.

16. *Species-specific assessments* provide a rapid appraisal of the status of a particular species or taxonomic group in a given area. The assessment provides more detailed biological information about the focus species within the context of its protection, use, or eradication (in the case of invasive species). Thus, this assessment type generally pertains to ecologically or economically important species and can provide rapid information about an important species in an area where its status is unknown or of particular interest. Likewise, the assessment can be used to confirm the status of species as threatened, endangered, or stable in a certain area. Data and output information focus on the target species within ecological, behavioural, cultural, and economic contexts. Case study II in Annex IV provides an example of a species-specific assessment.

17. *Change assessments* are undertaken in order to determine the effects of human activities (pollution, physical alterations, etc.) or natural disturbances (storms etc.) on the ecological integrity and associated biodiversity of an area. The information collected in this type of assessment can be either retroactive or proactive in nature. A retroactive approach aims to assess *actual* disturbances or alterations of various projects or management practices as they apply to biodiversity and biological integrity. In terms of biodiversity, this approach can be difficult without pre-disturbance (baseline) data for comparison, and therefore may require trend analyses or the use of reference sites or environmental quality standards (EQS), and may require methods that are not considered "rapid". Case study III in Annex IV provides an example of a change assessment.

18. *Indicator assessments* assume that biological diversity, in terms of species and community diversity, can tell us a great deal about the water quality, hydrology and overall health of particular ecosystems. Biomonitoring is often associated with this type of assessment. Biomonitoring traditionally refers to the use of biological indicators to monitor levels of toxicity and chemical content, but recently this type of approach has been more broadly applied to monitor the overall health of a system rather than its physical and chemical parameters alone. Case study IV in Annex IV provides an example of an indicator assessment.

19. *Resource assessments* aim to determine the potential for sustainable use of biological resources in a given area or water system. Data pertains to the presence, status and condition of economically important species, species on which livelihoods depend, or those with a potential for marketing. Ideally a resource assessment can facilitate the undertaking of ecologically sustainable development as an alternative to other destructive or unsustainable enterprises. Thus, a major objective of the resource assessment is to develop or determine sustainable use practices as viable economic options in areas with rich biological resources. For this reason, an important factor of resource assessment is the involvement of local communities and governments, for example through community biodiversity surveys. This integrative approach is important to the successful implementation of any sustainable harvesting system. Another extension of a resource assessment may be to provide baseline information used to monitor the health of fisheries and other resources. Case studies Va and Vb in Annex IV provide examples of a resource assessment.

Figure 2. Decision Tree

Decision Tree					
General Purpose	Biodiversity Baseline		Disturbance and Ecosystem Health		Resource Sustainability and Economics
COLUMN	I	II	III	IV	V
Specific Purposes	Baseline inventory, prioritization, conservation, identification	Conservation of specific species, status of alien species	Change detection	Overall ecosystem health or condition	Sustainable use of biological resources
Assessment Type	Inventory Assessment	Species-specific Assessment	Change Assessment	Indicator Assessment	Resource Assessment
CBD article	7a	7a, 8h	7b, 7c	7b, 7c	7b, 7c, 8i
Output Options	1.Species lists/inventories. 2. Habitat type lists/inventories. 3. Limited data on population size/ structure, community structure and function, and species interactions 4. Abundances, distribution patterns, and ranges. 5. Genetic information. 6. Important species: threatened, endangered 1, endemics, migratory, invasive alien species, other significance: cultural, scientific, economic, nutritional, social.	1. Status of a focal species: distribution, abundance, population size/ structure, genetic, health, size, species interactions, nesting, breeding and feeding information. 2. Ecological data on focal species; habitat, symbionts, predators, prey etc. 3. Threats to focal species and habitats. 4. Life history table. 5. Water quality data. 6. Hydrological information	1. Monitoring data. 2. Effects of an activity or disturbance on habitat/species/ communities: diversity loss, genetic issues, habitat changes or loss. 3. Monitor impacts. 4. Determine changes in ecological character. 5. Impact reduction options. 6. Biotic indices. 7. Habitat indices. 8. Water quality data. 9. Hydrological information 10. Early warning	1. Data on health or condition of ecosystems. 2. Water quality data. 3. Hydrological information. 4. Biological parameters. 5. Biotic indices.	1. Presence, status and condition of economically, culturally, nutritionally, and socially important species. 2. Information on sustainability of use of a species. 3. Limited monitoring data: stock assessment data, habitat status. 4. Limited information relevant to resource management. 5. Water quality data. 6. Hydrological information.

1/ See IUCN Red List Categories http://www.iucn.org/themes/ssc/redlists/categor.htm

	7. Diversity indices 8. Water quality data 9. Hydrological information		indicators		
May depend on *		Inventory Assessment	Inventory Assessment*		Species-specific Assessment
To define scope go to Appendix 2	**Table 3**	**Table 4**	**Table 5**	**Table 6**	**Table 7**

Defining the scope

20. After the purpose of the assessment has been determined, the next step in the process will define the scope of the assessment, taking into account available resources. Potential resource limitations may exist in terms of available **time, money and expertise**, and such limitations determine the methodologies available for a particular assessment project. Furthermore, they define the project in terms of its scope in the following areas: ***Taxa, Geography, Site Selection, Analysis, Data, Sampling Methods.*** These are important components of a biodiversity assessment and the scope, or capacity of each vary depending on the project needs and its resource limitations.

21. In order to define the scope of the assessment, the reader should proceed to the tables in Annex I to this document as follows:

- For **inventory assessment** – proceed to **table 3**
- For **species-specific assessment** – proceed to **table 4**
- For **change assessment** – proceed to **table 5**
- For **inventory assessment** – proceed to **table 6**
- For **resource assessment** – proceed to **table 7**

22. The available time, money and expertise form the topmost categories of the tables in Annex 2, and their availability determines to a great extent how ambitious the scope of the assessment can be in terms of taxonomy, geography, amount and type of data collected, etc. The following section provides the user a brief explanation of each of the categories in the tables.

Time

23. Although the definition of "rapid" is flexible, the term imparts that time is of the essence. The time frames used in the tables are broadly based on typical lengths of *rapid* biodiversity assessments and are separated as follows: *short* (1-7 days), *medium* (8-30 days), and *long* (30+ days). This refers to the amount of time to complete the entire project from start to finish, including transport, data collection, and preliminary analysis. Final analysis and results may take more time, but preliminary conclusions are important and need to be available quickly, else the purpose of a *rapid* assessment is lost.

Money

24. The amount of funding available for an assessment will, along with time, determine the capabilities and scope of a rapid biodiversity assessment. Because monetary amounts are relative, and broad categories cannot account for the fluid nature of currency values, a simple categorization is used. This is not based on values or actual monetary amounts, but rather on the relative amount of funding available to carry out the assessment. Therefore, available capital for a given assessment is either *Limited*, meaning that it can be considered limiting, or less than desired to carry out the objectives of the project, or *Ample*, meaning that there is enough money to carry out all elements of the assessment in a scientifically sound and usable way.

Expertise

25. For the purposes of this document, an expert can be defined as someone who can identify specimens of a taxonomic group to the species level, is familiar with current sampling and collection methods, can analyse data, and is familiar with the taxonomic group within a larger biological and ecological context. It does not refer to people with a general understanding or basic knowledge in the field.

26. Institutional support refers to the use of technical facilities for analysis, storage of data, and other forms of support. Expertise should be considered with the availability of institutional support, as a limitation to the capacity and scope of any project. The decision tree delineates this category as 'yes' or 'no', meaning that individuals who are experts in the field of study (including local experts) are or are not available for the assessment project.

Taxonomic scope

27. The taxonomic scope depends on how many and which taxonomic groups will be involved in the study. Some surveys may focus solely on major benthic cover types, while others may include fish, invertebrates, and other taxonomic groups. Typically the purpose of the assessment will determine which groups are pertinent to the study, as certain taxonomic groups will be more or less useful in certain assessment types.

Geographical scope

28. The geographic scope of an assessment depends on the taxonomic groups involved and/or the size of the area relevant to the project. The geographic scope can vary depending upon the extent of a particular ecosystem or habitat, the range of a particular species, or the area affected by an impact. The geographic scope will also vary depending on how large an area must be studied in order to obtain statistically sound data.

Data

29. In the context of rapid assessment, data used should be of the appropriate type and quality for their intended use. If more resources are available in time, money and expertise, the possibilities of obtaining reliable data and sound statistical results are higher. In addition, it is important to gather pre-existing information on the site, the species, and the habitats to gain better insight on the types of data, sampling designs and analyses needed in the assessment. The tables give an indication of the general types of data that would be collected in the context of the assessment.

Site Selection

30. Site selection refers to the number and type of sites needed for the assessment. The number of sites is dealt with in the section data and analysis. Like the geographic scope, the site

selection is highly dependent on other aspects of the assessment. An inventory requires a relatively broad assessment of the biodiversity at several sites with variable habitats. A species-specific assessment would concentrate on habitats used by the target species, and may forego several sampling sites in order to provide greater depth of study in fewer sites. Site selection for an impact assessment would concentrate on sites associated with the impact in question. Resource assessment sites focus on areas that could be used for exploitation. An indicator assessment would include as many sites as are needed to produce the necessary data.

Methods

31. The type of sampling methods used is determined according to the objective of the assessment. Table 8 in Annex II provides an overview of a number of relevant sampling methods for habitats, major taxonomic groups and water quality.

Analysis

32. Depending on the data collected and the purpose of the assessment, methods used for analyses could be simple descriptive, univariate, EDA (exploratory data analysis), or multivariate (clustering, similarity analysis, ordination, MANOVA). The table offers some suggestions on the general types of analysis that will be required for each assessment type.

Annex I

DEFINING THE SCOPE

Table 3. Inventory Assessment (field studies). Programmes and projects carrying out this assessment.

Time	**Short (1-7 days)**				**Medium (8-30 days)**				**Long (30+ days)**			
Money	**Limited**		**Ample**		**Limited**		**Ample**		**Limited**		**Ample**	
Expertise	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Taxa	Easily identified and sampled species (birds, mammals, selected fish, macroinvertebrates, selected herpetofauna)	Selected groups that can be easily identified with field guides	Expand taxa because more people can sample; easily identified	Several groups that can be easily identified with field guides	Selected taxa with more information, or several taxa with less information	Several groups that can be easily identified with field guides	All taxon (designate a scientist per taxon)	Several groups that can be easily identified with field guides	Several groups that can be easily identified with field guides	Groups that can be easily identified with field guides	All taxon	Groups that can be easily identified with field guides
Geographical	Few accessible target sites	Few accessible target sites	Few accessible or less accessible sites (fly/ sail in)	Few accessible or less accessible sites (fly/ sail in)	Several accessible and a few less accessible sites (fly/ sail in)	Several accessible and a few less accessible sites (fly/ sail in)	Most different habitat types	Several accessible and less accessible sites (fly/ sail in)	Several accessible and less accessible sites (fly/ sail in)	Several accessible and less accessible sites (fly/ sail in)	All important sites	All important sites
Data	Incomplete species list, estimate of relative, general habitat characteristics, special species, invasives, water parameters (physical, chemical)	Nontechnical, and require no experience, short, inexpensive	Species list, estimated of abundance, general habitat characteristics, special species, invasive, water quality and crude species abundance, distribution and health	Partial species list, general habitat characteristics, water quality, some distribution data	Species list, est. of abundance, general habitat characteristics, special species, invasive, water quality, health, limited behavior and small range distribution	Partial species list, general habitat characteristics, invasive, water quality, some small range distribution of limited taxa, limited behavior	Species list, abundance habitat characteristics, invasives, special species, water quality, health, distribution, some behavior	Partial species list, general habitat characteristics, invasives, water quality, some small range distribution of limited taxa, some behavior	Species list, abundance habitat characteristics, invasives, special species, water quality, health, distribution, behavior and interactions	Partial species list, general habitat characteristics, invasives, water quality, some small range distribution of limited taxa, behavior	Species list, abundance habitat characteristics, invasives, special species, water quality, health, distribution, behavior and interactions	Partial species list, general habitat characteristics, invasives, water quality, some small range distribution of limited taxa, behavior

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Time	Short (1-7 days)				Medium (8-30 days)				Long (30+ days)			
Money	**Limited**		**Ample**		**Limited**		**Ample**		**Limited**		**Ample**	
Expertise	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Site Selection	A few areas with varied microhabitats	A few areas with varied microhabitats	Several different habitats types	Several different habitats types	Several different habitats types	Several different habitats types	Most important sites, accessible or inaccessible	Most different habitat types	Most different habitat types	Most different habitat types	Most different habitat types	Most different habitat types
Methods*	Require short time, but produce biggest and most varied yield of organisms, cheap, identification in field-minimal collecting	Incomplete species list, general habitat characteristic, water quality	Short, more equipment, possibly technical, hire people to identify and collect	Require no experience, short	Several methods, some general, some species specific, inexpensive	Several methods, some general, some species specific, nontechnical	Lists, abundance, distribution patterns, behavior	Several methods, some general, some species specific, nontechnical	Various methods, inexpensive, can be time intensive and technical	Various methods, inexpensive, can be time intensive	All necessary and suitable methods	Various methods, can be time intensive
Analysis	Lists, counts, simple biotic indices, indicator species	Lists, counts	Include more taxa on lists, counts, simple biotic indices	Lists, counts, water analysis	More thorough anlaysis of abundance; limited distribution	Lists, counts, water analysis, scant distribution analysis	Lists, counts, water analysis, partial distribution patterns	Lists, counts, water analysis, partial distribution patterns	Lists, counts, water analysis, partial distribution patterns	Lists, abundance, distribution patterns	Lists, abundance, distribution patterns, behaviors	Lists, abundance, distribution patterns

PROGRAM	REFERENCE
Project Protección de la biodiversidad y desarrollo sostenible en el ecosistema Sabana-Camaguey.	Alcolado, P.M., E.E. García-Rivera y N. Espinosa (editores). 1999. Protección de la biodiversidad y desarrollo sostenible en el ecosistema Sabana-Camaguey. CESYTA. 145p p.
Rapid Assessment Program of the Center for Applied Biodiversity Science at Conservation International	http://www.biodiversityscience.org/xp/CABS/research/rap/aboutrap.xml
UNEP World Conservation Monitoring Center	http://www.wri.org/marine/
DIVERSITAS	http://www.biologie.uni-hamburg.de/b-online/library/IBOY/mooney_essay.html

*Evaluate and choose specific methods from Table 8 (Appendix 3) depending on time and money, and habitat types sampled.

Table 4. Species-specific assessment. Programmes and projects carrying out this assessment.

Time	**Short (1-7 days)**				**Medium (8-30 days)**				**Long (30+ days)**			
Money	**Limited**		**Ample**		**Limited**		**Ample**		**Limited**		**Ample**	
Expertise	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Target species	Target species	Target species	Target species	Target species	Target species	Target species	Target species	Target species	Target species	Target species	Target species	Target species
Geographi-cal	Limited, expected sites for species	Limited, expected sites for species	Limited in number, but not in accessibility (fly/sail to inaccessible sites)	Limited in number, but not in accessibility (fly/sail to inaccessible sites)	Several accessible, a few less accessible sites (fly/sail to inaccessible sites)	Several accessible, a few less accessible sites (fly/sail to inaccessible sites)	Many accessible and inaccessible sites (fly/sail to inaccessible sites)	Many accessible and inaccessible sites (fly/sail to inaccessible sites)	Many accessible sites and several less accessible sites (fly/sail to inaccessible sites)	Many accessible sites and several less accessible sites (fly/sail to inaccessible sites)	Many accessible sites and several inaccessible sites (fly/sail to inaccessible sites)	Many accessible sites and several inaccessible sites (fly/sail to inaccessible sites)
Data	Presence/ absence, limited distribution, health, habitat status snapshot	Presence/ absence, physical characteristics, habitat description, very limited distribution	Presence/ absence, distribution, health, habitat status, relative abundance, population information		Presence/ absence, distribution, health, habitat status, relative abundance, population information, some behavior	Presence/ absence, limited distribution, physical characteristics, habitat features, relationships among species	All previous including, status of food source and competition, relationships among species, DNA extractions	Presence/ absence, limited distribution, physical characteristics, habitat features	All previous plus some seasonal behavior	Presence/ absence, limited distribution, physical characteristics, habitat features, some basic behavior	All previous	Presence/ absence, limited distribution, physical characteristics, habitat features, some basic behavior
Site Selection	Where species is expected, accessible	Where species is expected, accessible	Where species is expected (or not expected), accessible and inaccessible	Where species is expected, accessible and inaccessible	Where species is expected or not expected, accessible and a few less accessible	Where species is expected, accessible and some less accessible	Where species is expected or not expected, accessible and inaccessible	Where species is expected, accessible and inaccessible	Where species is expected or not expected, accessible and less accessible	Where species is expected, accessible and less accessible	Where species is expected or not expected, accessible and inaccessible	Where species is expected, accessible and inaccessible

Time	Short (1-7 days)				Medium (8-30 days)				Long (30+ days)			
Money	**Limited**		**Ample**		**Limited**		**Ample**		**Limited**		**Ample**	
Expertise	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Methods*	Species specific, fast, inexpensive	Species specific, nontechnical, fast, inexpensive	Species specific plus other useful, but more general methods, can include technical and more expensive methods	A variety of methods, nontechnical	A variety of methods, inexpensive	A variety of methods, nontechnical, can include more time intensive methods	Can include technical, more expensive, and some more time intensive methods	A variety of methods, nontechnical, can include more time and labor intensive methods	Can include technical, time intensive methods, some in depth surveys and short-term behavior monitoring	A variety of methods, nontechnical, can include more time and labor intensive methods	Can include technical, expensive, and time intensive methods, some in depth surveys and short-term behavior monitoring	A variety of methods, nontechnical, but possibly costly can include more time and labor intensive methods
Analysis	Status report, limited distribution, population information	Status, very limited distribution, limited population information	Status, distribution, relative abundance, population information and structure	Status, distribution, limited population information	Status, distribution, relative abundance, population information and structure, some behavior	Status, distribution, limited population information	Status, distribution, relative abundance, population information and structure, some behavior, status of food sources and competition, species invasive, genetic information	Status, distribution, limited population information	Status, distribution, relative abundance, population information and structure, some behavior, status of food sources and competition, species invasive	Status, distribution, limited population information, limited behavioral analysis	Status, distribution, relative abundance, population information and structure, some behavior, status of food sources and competition, species invasive, genetic information	Status, distribution, limited population information, limited behavioral analysis

PROGRAM	REFERENCE
Project Protección de la biodiversidad y desarrollo sostenible en el ecosistema Sabana-Camaguey.	Alcolado, P.M., E.E. García-Rivera y N. Espinosa (editores). 1999. Protección de la biodiversidad y desarrollo sostenible en el ecosistema Sabana-Camaguey. CESYTA. 145p p.
Rapid Assessment Program of the Center for Applied Biodiversity Science at Conservation International	http://www.biodiversityscience.org/xp/CABS/research/rap/aboutrap.xml
UNEP World Conservation Monitoring Center	http://www.wri.org/marine/
The Trilateral Monitoring and Assessment Programme (TMAP) of the Common Waden Sea Secretariat	http://cwss.www.de/TMAP/Monitoring.html

Assessment of the State of the Marine Environment of the Baltic Sea of the Baltic Marine Environment Protection Commission	http://www.helcom.fi/Monas/4padec02.pdf
FAO Fisheries Statistics	http://www.fao.org/fi/statist/statist.asp
PROGRAM	**REFERENCE**
State of the World's Fisheries and Aquaculture	http://www.fao.org/sof/sofia/index_en.htm
South Pacific Regional Comparative Resource Assessment Project of the Secretariat to the Pacific Community Coastal Fisheries Programme	http://www.spc.org.nc/coastfish/Projects/EURAD.HTM
CARICOM Fisheries Resource Assessment and Management Program (CFRAMP)	http://www.caricom-fisheries.com/cframp.htm
The Reef Environmental Education Fundation (REEF)	http://www.reef.org/data/surveyproject.htm
Commonwealth Scientific and Industrial Research Organization	http://www.marine.csiro.au/LeafletsFolder/mapoz.html
National Institute of Water and Atmospheric Research of New Zealand	http://www.niwa.cri.nz/rc/biodiv/
Global Coral Reef Monitoring Network (GCRMN)	English, Wilkinson and Baker (eds). 1997.
Earthwatch Institute	http://www.earthwatch.org/expeditions/sullivan_02/theproject.html#methods
Estuarine Research Federation	http://erf.org/user-cgi/conference_abstract.pl?conference=erf2001&id=695
MIT Sea Grant College Program	http://massbay.mit.edu/exoticspecies/conferences/2000/abstracts08.html#12
Washington State Exotics Expedition 2000	http://faculty.washington.edu/cemills/WSX2000.pdf
Puget Sound Expedition 1998	http://faculty.washington.edu/cemills/MillsPublications.html
American Samoa Coral Reef Management Program	http://dusk.geo.orst.edu/djl/samoa/ssekey/

* Evaluate and choose specific methods from Table 8 (Appendix 3) depending on time and money, and habitat types sampled.

Table 5. Change assessment. Programmes and projects carrying out this assessment.

Time	All
Money	All
Expertise	All
Taxa	Inventory, species specific, or biodiversity indicators
Geographical	Sites in impact zone
Data	For inventory data, see Table 3
	For species specific data, see Table 4
	For data using biodiversity as an indicator of condition, see Table 6
Site Selection	Selected sites of highest concern
Methods*	For inventory methods, see Table 3
	For species specific methods, see Table 4
	For methods using biodiversity as an indicator of health, see Table 6
Analysis	For inventory analysis, see Table 3
	For species specific analysis, see Table 4
	For analysis using biodiversity as an indicator of health, see Table 6

PROGRAMME	REFERENCE
Project Protección de la biodiversidad y desarrollo sostenible en el ecosistema Sabana-Camaguey.	Alcolado, P.M., E.E. García-Rivera y N. Espinosa (editores). 1999. Protección de la biodiversidad y desarrollo sostenible en el ecosistema Sabana-Camaguey. CESYTA. 145 p.
Global International Waters Assessment (GIWA)	http://www.giwa.net
Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)	http://gesamp.imo.org
Land-Ocean Interactions in the Coastal Zone (LOICZ)	http://www.nioz.nl/loicz/
IOC Harmful Algal Bloom Program	http://ioc.unesco.org/hab/default.htm
Coral Reef Degradation in the Indian Ocean (CORDIO)	http://www.cordio.org/
Rapid Assessment Program of the Center for Applied Biodiversity Science at Conservation International	http://www.biodiversityscience.org/xp/CABS/research/rap/aboutrap.xml

World Resources Institute	http://www.wri.org/marine/
PROGRAMME	**REFERENCE**
UNEP World Conservation Monitoring Centre	http://www.wri.org/marine/
Vitareef Program of the University of Charleston	http://www.cofc.edu/~coral/Vitareef/vitareef.htm
The Trilateral Monitoring and Assessment Programme (TMAP) of the Common Waden Sea Secretariat	http://cwss.www.de/TMAP/Monitoring.html
The Convention for the Protection of the Marine Environment of the North-East Atlantic ("OSPAR Convention")	http://www.ospar.org/eng/html/welcome.html
Assessment of the State of the Marine Environment of the Baltic Sea of the Baltic Marine Environment Protection Commission	http://www.helcom.fi/Monas/4padec02.pdf
Marine Conservation East Asian Seas Regional Coordinating Unit of the UNEP	http://206.67.58.208/uneproap/text/conventions.htm
International Council for Science (ICSU)	http://www.icsu.org/Library/ProcRep/AR2001-IIB/AR2001-SCOPE.pdf
Earthwatch Institute	http://www.earthwatch.org/expeditions/sullivan_02/theproject.html#methods
Project “Coastal Zone Management Component of the Central American Environment	http://www.eco-index.org/search/results.cfm?ProjectID=71
DIVERSITAS	http://www.biologie.uni-hamburg.de/b-online/library/IBOY/mooney_essay.html

* Evaluate and choose specific methods from table 8 (appendix 3) depending on time and money, and habitat types sampled.

Table 6. Indicator assessment. Programmes and projects carrying out this assessment.

Time	Short (1-7 days)				Medium (8-30 days)				Long (30+ days)			
Money	**Limited**		**Ample**		**Limited**		**Ample**		**Limited**		**Ample**	
Expertise	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Taxa	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis	Selected groups needed for selected Index or analysis
Geographical	Few key sites where impacts would be expected, as well as at least one control site	Few key sites where impacts would be expected, as well as at least one control site	Sites where impacts would be expected, as well as control sites	Sites where impacts would be expected, as well as control sites	Few key sites where impacts would be expected, as well as at least one control site	Few key sites where impacts would be expected, as well as at least one control sites	Sites where impacts would be expected, as well as control sites	Sites where impacts would be expected, as well as control site	Few key sites where impacts would be expected, as well as at least one control site	Few key sites where impacts would be expected, as well as at least one control site	Sites where impacts would be expected, as well as control sites	Sites where impacts would be expected, as well as control sites
Data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data	Basic data needed for water quality analysis, limited species richness data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data	Basic data needed for water quality analysis, limited species richness data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data	Basic data needed for water quality analysis, limited species richness data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data	Data required for the Index or Analysis, water quality data, species richness, trophic data, abundance data
Site Selection	Few key sites where impacts would be expected, as well as at least one control site	Few key sites where impacts would be expected, as well as at least one control site	Sites where impacts would be expected, as well as control sites	Sites where impacts would be expected, as well as control sites	Few key sites where impacts would be expected, as well as at least one control site	Few key sites where impacts would be expected, as well as at least one control sites	Sites where impacts would be expected, as well as control sites	Sites where impacts would be expected, as well as control site	Few key sites where impacts would be expected, as well as at least one control site	Few key sites where impacts would be expected, as well as at least one control site	Sites where impacts would be expected, as well as control sites	Sites where impacts would be expected, as well as control sites

Time	Short (1-7 days)				Medium (8-30 days)				Long (30+ days)			
Money	Limited		Ample		Limited		Ample		Limited		Ample	
Expertise	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Methods*	Water quality samples, basic fish collecting, limited invertebrate collecting, identifications to species, inexpensive and fast	Basic water quality samples, basic fish collecting, limited invertebrate collecting, identifications to order and family level, inexpensive and fast, nontechnical	More complete water quality sampling and analysis, fish and invertebrate sampling, fast	Basic water quality samples, basic fish collecting, limited invertebrate collecting, identifications to order and family level, fast	Water quality samples, basic fish collecting, limited invertebrate collecting, identifications to species, inexpensive and fast	Basic water quality samples, basic fish collecting, limited invertebrate collecting, identifications to order and family level, inexpensive and fast, nontechnical	More complete water quality sampling and analysis, fish and invertebrate sampling, fast	Basic water quality samples, basic fish collecting, limited invertebrate collecting, identifications to order and family level, fast	Water quality samples, basic fish collecting, limited invertebrate collecting, identifications to species, inexpensive and fast	Basic water quality samples, basic fish collecting, limited invertebrate collecting, identifications to order and family level, inexpensive and fast, nontechnical	More complete water quality sampling and analysis, fish and invertebrate sampling, fast	Basic water quality samples, basic fish collecting, limited invertebrate collecting, identifications to order and family level, fast
Analysis	BiomMAP, IBI, Visual Assessment analyses	Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses	BiomMAP, IBI, Visual Assessment analyses

PROGRAM	REFERENCE
Atlantic and Gulf Rapid Reef Assessment (AGRRA)	http://coral.aoml.noaa.gov/agrra/
Global Ocean Observing System (GOOS)	http://ioc.unesco.org/goos
Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)	http://gesamp.imo.org
Ad Hoc Benthic Indicator Group	http://ioc.unesco.org/benthicindicators/
International Coral Reef Initiative (ICRI)	http://icriforum.org/
Reef Check	http://www.reefcheck.org/
Rapid Assessment Program of the Center for Applied Biodiversity Science at Conservation International	http://www.biodiversityscience.org/xp/CABS/research/rap/aboutrap.xml
UNEP World Conservation Monitoring Center	http://www.wri.org/marine/
Northwest Hawaiian Islands Rapid Reef Assessment and Monitoring Program	
The Australian Institute of Marine Science (AIMS) Monitoring Program (video transects)	http://www.aims.gov.au/pages/research/reef-monitoring/reef-monitoring-index.html
The Arctic Monitoring and Assessment Programme (AMAP) (Pollution)	http://www.amap.no/
The Trilateral Monitoring and Assessment Programme (TMAP) of the Common Waden Sea Secretariat	http://cwss.www.de/TMAP/Monitoring.html
The Convention for the Protection of the Marine Environment of the North-East Atlantic ("OSPAR Convention")	http://www.ospar.org/eng/html/welcome.html
Assessment of the State of the Marine Environment of the Baltic Sea of the Baltic Marine Environment Protection Commission	http://www.helcom.fi/Monas/4padec02.pdf

Rapid Assessment of Marine Pollution (RAMP) (Abiotic indicators)	http://www.coexploration.org/ramp/index.htm
Baltic On-Line Interactive Geographical and Evironmental Information Service (BOING) of the Stockholm University (Abiotic indicators)	http://data.ecology.su.se/boing/index.html
PROGRAM	**REFERENCE**
Delft Hydraulics, the Netherlands	http://www.wldelft.nl/cons/area/mes/riskas/
Commonwealth Scientific and Industrial Research Organization	http://www.marine.csiro.au/LeafletsFolder/mapoz.html
Project Implementation and networking of large scale long term marine biodiversity research in Europe (BIOMARE)	http://ww2.obs-banyuls.fr/apachehtdocs/biomare/instructions.php4
Global Coral Reef Monitoring Network (GCRMN)	English, Wilkinson and Baker (eds). 1997.
International Council for Science (ICSU)	http://www.icsu.org/Library/ProcRep/AR2001-IIB/AR2001-SCOPE.pdf
World Wildlife Fund Rapid Assessment of Lomaiviti group, Fiji	http://www.wwfpacific.org.fj/bulletin16_feature.htm
Earthwatch Institute	http://www.earthwatch.org/expeditions/sullivan_02/theproject.html#methods
University of North Carolina Assessment Program	http://people.uncw.edu/durakom/
Biodiversity Conservation Prioritisation Project, India	http://www.cbsg.org/reports/exec_sum/indian_mangroves_camp.pdf

* Evaluate and choose specific methods from Table 8 (Appendix 3) depending on time and money, and habitat types sampled.

Table 7. Resource assessment. Programmes and projects carrying out this assessment.

Time	Short (1-7 days)				Medium (8-30 days)				Long (30+ days)			
Money	**Limited**		**Ample**		**Limited**		**Ample**		**Limited**		**Ample**	
Expertise	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Taxa	Economic species	Economic species	Economic species	Economic species	Economic species	Economic species	Economic species	Economic species	Economic species	Economic species	Economic species	Economic species
Geographical	Few accessible sites	Few accessible sites	Several accessible or less accessible sites	Several accessible or less accessible sites	Several accessible or less accessible sites	Several accessible or less accessible sites	Several accessible and less accessible sites	Several accessible and less accessible sites	Many accessible/ less accessible sites	Many accessible/ less accessible sites	All necessary sites	All necessary sites
Data	Number sampled of species; health; age; sex; other species; water quality; habitat characteristics; food source; predators	Number sampled of species; habitat characteristics	Number sampled of species; health; age; sex; other species; water quality; habitat characteristics; food source; predators	Number sampled of species; habitat characteristics	Number sampled of species; health; age; sex; other species; water quality; habitat characteristics; details of food source; details of predators; some behavior; DNA extractions	Number sampled of species; habitat characteristics (more samples)	Number sampled of species; health; age; sex; other species; water quality; habitat characteristics; details of food source; details of predators; some behavior; DNA extractions; distribution	Number sampled of species; habitat characteristics; distribution; (more samples)	Number sampled of species; health; age; sex; other species; water quality; habitat characteristics; details of food source; details of predators; some behavior; DNA extractions; distribution; some seasonal behavior	Number sampled of species; habitat characteristics; distribution; (more samples)	Number sampled of species; health; age; sex; other species; water quality; habitat characteristics; details of food source; details of predators; some behavior; DNA extractions; distribution; some seasonal behavior	Number sampled of species; habitat characteristics; distribution; (more samples)
Site Selection	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species	Locations known to have species

Time	Short (1-7 days)				Medium (8-30 days)				Long (30+ days)			
Money	**Limited**		**Ample**		**Limited**		**Ample**		**Limited**		**Ample**	
Expertise	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Methods*	Species specific; inexpensive; fast	Species specific; inexpensive; fast; nontechnical	Species specific; fast; possibly more costly	Species specific; possibly more costly; fast; nontechnical	Species specific; inexpensive; more intensive or extensive	Species specific; inexpensive; nontechnical; more intensive or extensive	Species specific; more intensive or extensive; possibly costly	Species specific; more intensive or extensive; possibly costly; nontechnical	Species specific; even more intensive or extensive; longer term	Species specific; inexpensive; nontechnical; even more intensive or extensive	Species specific; even more intensive or extensive; longer term	Species specific; inexpensive; nontechnical; even more intensive or extensive
Analysis	Estimate abundance and richness; sizes; age; sex ratios; major competition; health; availability of food; habitat characteristics, interactions; water quality; stock assessments	Abundance, sizes, habitat characteristics	Estimate abundance and richness; sizes; age; sex ratios; major competition; health; availability of food; habitat characteristics, interactions; water quality; stock assessments	Abundance, sizes, habitat characteristics	Estimate abundance and richness; sizes; age; sex ratios; major competition; health; availability and condition of food source; habitat characteristics, interactions; water quality; stock assessments; condition of predators; genetic information	Abundance, sizes, habitat characteristics	Estimate abundance and richness; sizes; age; sex ratios; major competition; health; availability and condition of food source; habitat characteristics, interactions; water quality; stock assessments; condition of predators; distribution	Abundance, sizes, habitat characteristics; distribution	Estimate abundance and richness; sizes; age; sex ratios; major competition; health; availability and condition of food source; habitat characteristics, interactions; water quality; stock assessments; condition of predators; distribution; seasonal behavioral patterns; total or partial economic valuation	Abundance, sizes, habitat characteristics; distribution	Estimate abundance and richness; sizes; age; sex ratios; major competition; health; availability and condition of food source; habitat characteristics, interactions; water quality; stock assessments; condition of predators; distribution; seasonal behavioral patterns; total or partial economic valuation	Abundance, sizes, habitat characteristics; distribution

PROGRAM	REFERENCE
Rapid Assessment Program of the Center for Applied Biodiversity Science at Conservation International	http://www.biodiversityscience.org/xp/CABS/research/rap/aboutrap.xml
UNEP World Conservation Monitoring Center	http://www.wri.org/marine/
The Trilateral Monitoring and Assessment Programme (TMAP) of the Common Waden Sea Secretariat	http://cwss.www.de/TMAP/Monitoring.html

The Convention for the Protection of the Marine Environment of the North-East Atlantic ("OSPAR Convention")	http://www.ospar.org/eng/html/welcome.html
Assessment of the State of the Marine Environment of the Baltic Sea of the Baltic Marine Environment Protection Commission	http://www.helcom.fi/Monas/4padec02.pdf
PROGRAM	**REFERENCE**
FAO Fisheries Statistics	http://www.fao.org/fi/statist/statist.asp
State of the World's Fisheries and Aquaculture	http://www.fao.org/sof/sofia/index_en.htm
South Pacific Regional Comparative Resource Assessment Project of the Secretariat to the Pacific Community Coastal Fisheries Programme	http://www.spc.org.nc/coastfish/Projects/EURAD.HTM
CARICOM Fisheries Resource Assessment and Management Program (CFRAMP)	http://www.caricom-fisheries.com/cframp.htm
Rapid Assessment of Management Parameters of the WorldFish Center	http://www.worldfishcenter.org/Op_2001.htm
The Artificial Reef Society of British Columbia (ARSBC)	http://www.artificialreef.bc.ca/Resources/tjones.html
Project "Coastal Zone Management Component of the Central American Environment"	http://www.eco-index.org/search/results.cfm?ProjectID=71
Workshop on Sustainable Development Indicators in Taiwan	http://www.gio.gov.tw/taiwan-website/5-gp/eco/html/part5-3.htm

* Evaluate and choose specific methods from Table 8 (Appendix 3) depending on time and money, and habitat types sampled

Notes:

- Since the assessment types III, IV and V require information from assessment types I and II, most of the ones cited in this table deal with assessment I and II as well, but no always state whether they made the basic assessments or gather the info from other sources.
- All the programmes recorded in this table deal with assessments but all of them are not necessarily rapid.
- This table is the result of the review of some hundreds of references (mostly internet), but should not be considered a comprehensive review of all relevant assessments.

Annex II.

SAMPLING METHODS

Table 8. Sampling methods. Note: Cost estimations mostly calculated for equipment, chemicals (no salaries or fees)

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
Water Quality	Physical probes	pH, O2, temperature, Oxygen Biological Demand (OBD), alcalinity	short- 10 -30 minutes	$100-3000 depending on number of probes and quality	All water bodies	none	no	pH probe, temperature probe, dissolved oxygen probe, OBD collection equipmen titration equipment
	Secchi Disc	water transparency	short, 5-10 minutes	$10	All water bodies	none	no	Secchi disc
	Water sample collection and Lab analysis	total phosphorus, phosphates, total nitrogen, nitrites, nitrates, ammonium, silicates, chlorophyll-a	10 minutes in field, 3 hours in laboratory per sample	high - larboratory equipment	All water bodies	training in using laboratory equipment	water samples	spectrophotometer, filters, bottles, water samples, net for reactive phytoplancton
	visual assessment of sediment	sediment colour and type (organic, sandy clayish, etc)	fast- 1-5 minutes	0	all water bodies	none	sediment sample	grab sampler (can be done in conjunction with benthic invertebrate sampling)
Fish	seine net (various types, purse, beach)	mostly smaller fishes	1-4 hours	$50-$250/ net, depending on size	shallow water without strong current, for big nets a boat could be needed for deployment and pulling	skill in seining	yes, net does not kill fishes	seine net, boat, measuring boards, scales, sheets, pencils, slates, plasti bags, plastic labels, preservative, GPS
	Trawl (various types, beam, Otter)	Use only for fish and bottom-dwelling animals, can be very destructive to the environment	1-4 hours	$1000 for nets, boat rental and field assistance	Any waters without obstacles on the bottom or surface debris	skill in trawling	yes, nets kill fishes	trawl net, boat, measuring boards, scales, sheets, pencils, slates, plasti bags, plastic labels, preservative, GPS
	Scoop and tray nets	suitable for small fish near surface, use only against banks	1-5 hours	$5-$20/ net	Used in inaccessible areas, such as mangroves	Skill in using the nets but easy to learn	yes	Scoop and tray net, boat, measuring boards, scales, sheet pencils, slates, plasti bags, plastic labels, preservative, GPS

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
	Push net	Catches only small organism	1-2 hours	$5-$20/ net	Most shallow waters	Skill in using the nets but easy to learn	yes	Push net, boat, measuring boards, scales, sheets, pencils, slates, plasti bags, plastic labels, preservative, GPS
	Cast net	Suitable for small fish and prawns	1-2 hours	$50-$200/ net	Good for confined areas and shallow waters	Skill on cast. Operators vary on efficiency	yes	Cast net, boat, measuring boards, scales, sheets, pencils, slates, plasti bags, plastic labels, preservative, GPS
	Drop net	Small organisms	1-2 hours	$50-$100/ net	Good for small and shallow areas	Skills on construct and use. Labour intensive	yes	Drop net, boat, measuring boards, scales, sheets, pencils, slates, plasti bags, plastic labels, preservative, GPS
	Lift net	Small and rare species that must be concentrated	1-2 hours	$50-$100/ net	Good for small and shallow areas	Skills on use the net	yes	Lift net, boat, measuring boards, scales, sheets, pencils, slates, plasti bags, plastic labels, preservative, GPS
	Spear fishing (various types)	Suitable for all species but used primarily for big and selective species (difficult to catch by other means)	1-6 hours	$50-$200/ spear gun	Any but clear waters. Difficult areas	Skill is obtained by practicing	Yes	Spear gun and gear, boat, measuring boards, scales, sheet pencils, slates, plasti bags, plastic labels, preservative, GPS
	hook and line	suitable for any fish type and any water, depending on bait used	variable depending on repetition	variable depending on repetition	Any waters	skill in line fishing	yes	hook, line, bait, boat measuring boards, scales, sheets, pencils, slates, plasti bags, plastic labels, preservative, GPS
	Longline (drift or bottom)	Selective fish, according to bait used	12-24 hours-leave out overnight	$100-$300/ pe line, depending of number of hooks	Any water, except high-relief hard bottom	Skill in longlining	Yes	hook, line, bait, buoys, weights, boat measuring boards, scales, sheets, pencils, slates, plasti bags, plastic labels, preservative, GPS
	Kill nets (see note below)	all fish sizes and types, depending on mesh size	12-24 hours-leave out overnight	$50-$500/net	shallow to medium depth waters	Skill in setting the nets	yes	drift, trammel, block encircling and/or gil nets, boat, measurin boards, scales, sheet pencils, slates, plasti bags, plastic labels, preservative, GPS

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
	Trap nets (see note below)	Most fish sizes and types, primarily in shallow waters	12-24 hours, based on tides (barrier and bag) Corrals are set up for longer and collect every 24 hours or so	$50-$500/nets, corral depending on size	shallow waters	Skill in setting the nets. Corral required expert people (fishermen)	yes	Barrier, bag nets and/or fish corral, boat, measuring boards, scales, sheet pencils, slates, plasti bags, plastic labels, preservative, GPS
	fish traps	Mostly bottom living fishes	24 hours-leave out overnight	$50-100/trap	mostly shallow waters, for deeper waters a motorized winch is needed	Skill on setting traps in right places. Fishermen support advised	yes, trap does not kill fishes	fish traps (may be motorized winch), boat, measuring boards, scales, sheet pencils, slates, plasti bags, plastic labels, preservative, GPS
	Rotenone	All fish of the encircle area. Kill all the fish. Permit could be required	Minutes per site	$350/20 l	Encircle area with a net in shallow-open area. For deep waters, use it in caves and crevices	Skill on setting net	Yes	Rotenone, net, scoop net, measuring boards, scales, sheet pencils, slates, plasti bags, plastic labels, preservative, GPS
	dive/ snorkeling (transects, stationary, roving)	suitable for surveying clear waters	usually about 1 hour, but variable depending on repetition	low (snorkeling) to high (scuba)	All clear waters	diving needs certification Identification of species and survey design	No	snorkel/scuba gear, underwater sheets, pencils and slates
	questionnaire	ask local fishermen about the fishes they observe and use	2-4 hours	Low	All waters	Easy to apply but require knowledge to prepare it	No	Basic stuff for filling questionnaires
	sonars	suitable for schooling, pelagic fish, not very precise data	depending on the size of the water body	$100 - 1000	All waters, but mostly deep	Skill in operating the sonars	No	Sonar, boat, basic stuff for taking notes
Benthic macroinvertebrates	visual search/ snorkel/ dive (quadrats,intercept and band transects)	suitable for surveying clear waters and medium/big size animals	usually about 1 hour, but variable depending on repetition	low (snorkeling) to high (scuba)	All clear waters	diving needs certification	yes	snorkel/scuba gear, underwater sheets, slates and pencils, collecting material

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
	kick net	all invertebrates inhabiting hard substrates	1-5 hours	$55	good for wadable waters with gravel or stoney bottom	skill with kick nets	yes	kick net, basic stuff for taking notes and collecting material
	Dip net	suitable for sampling nectic animals in shallow waters	1-2 hours	$5-$20/ net	All waters	Skill in using dip nets	yes	dip net, basic stuff fo taking notes and collecting material
	Sledge	Semi-quantitative sampling. Suitable for epifauna (good info for caracterization)	About 1 site/hour	Not available	Sof-bottom habitats	Skill on sledging	Yes	Sledge, wire-mesh sieves, buoys, GPS, boat, sorting box, rope, jars and preservatives, waterproofs labels and pencils, forceps
	Dredge	At best, semi-quantitative data. Useful in broad area surveys and inventories	About 1 site/hour	$500-600/ dredge	Sof-bottom. Sample deeper into the substrate	Skill in dredging	Yes	Dredge, wire mesh sieves, GPS, boat, sorting box, rope, ja and preservatives, waterproofs labels and pencils, forceps
	Trawl	Larger epifauna and demersal nekton (complementary to other methods). Cualitative	1 site/2-3 hour	$1000 for nets, boat rental and field assistance	Soft-bottom	Skill in trawling	Yes	Trawl, wire mesh sieves, GPS, boat, sorting box, rope, ja and preservatives, waterproofs labels and pencils, forceps
	Grab	Quantitative sampler of epifauna and infauna (particularly sedentary and slow-moving)	About 1 site/hour	$350- $1100	Sof-bottom habitats	Skill in using grab	yes	Grab, hopper with base, wire mesh sieves, Rose Bengal stain, buoys, GPS, boat, sorting box, rope, jars and preservatives, waterproofs labels and pencils, forceps
	Surber sampler	all invertebrates inhabiting stony or gravel substrates	1-3 hours	$200	gravel or stony bottom waters, mainly still waters	knowledge of using Surber and requirements to quantify data	yes	Surber sampler, bucket, preservative jars, basic stuff for taking notes
	Aerial nets	for catching adult invertebrates	1-5 hours	$35-$50	land	skill in using aerial nets	yes	insect net, jars, preservatives, basic stuff for taking notes

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
Zooplankton	box samplers	for plankton crustaceans and rotifers	1-3 hours	$100	Any water	skill in using samplers	yes	plankton (box) samplers, basic stuff for taking notes and collecting material
	Plankton nets	For plankton			Any water			
Macrophytes	visual search	note visible plants within certain area qualitative analysis	variable depending on area searched	Low	Any habitat (marine or coastal)	Identification of species	yes	Basic stuff for taking notes and collecting material
	Random sampling	qualitative, more unbiased than a visual search	1-5 hours	Low	Any habitat (marine or coastal)	Identification of species and survey design	yes	Basic stuff for taking notes and collecting material
	Plots (size variable depending on type of vegetation)	Any coastal and marine vegetation. including mangroves.	Variable, depending, but usually 1plot/hour	Low	Coastal habitats	Identification of species and survey design	Yes	Basic stuff for taking notes and collecting material, measuring tapes
	dive/ snorkeling (quadrants)	Suitable for surveying clear waters. Deep waters in case of dive	usually about 1 hour, but variable depending on repetition	low (snorkeling) to high (scuba)	All clear waters	diving needs certification. Identification of species and survey design	yes	snorkel/scuba gear, underwater sheets, slates and pencils, collecting material
	Grab	good, quantitative method	1-5 hours	$350- $1100	Vegetation associated to soft-bottom	Skills on use grabs	yes	Grab, hopper with base, buoys, GPS, boat, rope, jars and preservatives, waterproofs labels and pencils, forceps
Epiphytic macroinvertebrates	various samplers, depending on type of vegetation		1-4 hours	$100-$200/ sampler	Seagrass and macroalgal beds	skill in sampling	yes	tube or box samplers sieves, basics for taking notes, collecting material

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
Reptiles and Amphibians	dip nets (amphibians)	suitable for catching tadpoles	variable depending on repetition	$5-$20/ net	Any water where species occur	Skill in using dip nets	yes	dip net, basic stuff fo taking notes, collecting material
	visual search (amphibians/ reptiles)	good for locating relatively visible organisms	variable	Low	land and surface water	Knowledge of microhabitats	no	Basic stuff for taking notes
	Vocalizations	Listen for and sometimes record frog calls and identify species from call	Variable, several hours depending on search and record time	Low- tape recorder	Any habitat where species occur	Knowledge of frog calls and identify species from calls, habitats	No	Tape recorder, cassettes, playback, flashlights, basic stu for taking notes
	pitfall traps with drift fence (amphibians/ reptiles)	good for collecting animals that are difficult to sight; estimate relative abundance and richness	should be left out 24-48 hours	Low if old buckets are used	land	Skill in setting up pitfall traps with drift fences	yes	Buckets, hand shove metal for fence, basi stuff for taking notes collecting material
	litter search (amphibians/ reptiles)	usually used for finding frogs in conjunction with quaudrants	variable depending on repetition	Low	land	Minimal	yes	Basic stuff for taking notes, collecting material
	transects (amphibians/ reptiles)	used to control sample area to quantify and standardize data	dependant on length and number of transects	Low	Open land habitats where species occur	Knowledge of establishing transects	yes	Marking tape, basic stuff for taking notes collecting material
	Point counts	High species diversity and structurally complex areas	Depending the sampling area	Low	Several kind of land habitats	Knowledge on the biology of the local species	Yes	Basic stuff for taking notes or tape recorder, collecting material
	Snorkeling/ dive (reptiles)	used especially for looking for turtles	variable depending on repetition	low (snorkeling) to high (scuba)	Any water	Diving certification	yes	Snorkel/scuba gear, dip net, underwater sheets, slates and pencils

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
	nooses (reptiles)	suitable for lizards	depends on number of lizards sought	Low	Land	Skill in making noose and spotting lizards	yes	long, flexible, but strong weed/ rope, basic stuff for taking notes, collecting material
	turtle traps (reptiles)	used to trap turtles on land and water	at least 1 day	$65-$150/ trap	Water and/or riparian habitats	Knowledge on setting traps	yes	Turtle trap, bait, bas stuff for taking note collecting materials
	Questionnaire	Ask local people about the species they observe and use	2-4 hours	Low	All water bodies	Easy to apply but require knowledge to prepare it	no	Basic stuff for fillin questionnaires
Birds	airplane surveys	can get crude estimates of population numbers and relative population abundance; biased against certain species	1-2 hours	high- cost of hiring an airplane	any open areas	Experience in quickly recognizing species	no	Binoculars, basic stuff for taking note
	point counts (terrestrial species)	used to control sample area to quantify and standardize data - can be done on foot in dry season and canoe in wet season	1-5 hours	$100	Any land habitat where the species occur	Knowledge of parameters for carrying out and recording point counts	no	Binoculars, measuring tape, flagging, basic stuff for taking notes
	Transects(terrestrial and acuatic species)	used to control sample area to quantify and standardize data - can be done on foot in dry season and canoe in wet season	1-5 hours, but depending on the sampling area	$100	Any open habitat	Knowledge on the biology of the species and survey design	no	binoculars, measuring tape, flagging, basic stuff for taking notes
	vocalizations	listen for and sometimes record bird calls and identify species from call	variable, several hours depending on search and record time	low- tape recorder (if needed)	Any habitat where species occur	Knowledge of how to identify bird species from calls, habitats	no	tape recorder, cassettes, playback (needed), basic stuff for taking notes

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
	locate nesting sites	bird species nesting near water or on wet habitats	1-5 hours	$100	Any habitat where species occur	Knowledge of nesting habitats	no	binoculars, maps, basic stuff for taking notes
Mammals	Sighting	look for mammals	variable	$100	Any habitat where species occur	Minimal	no	binoculars if necessary, basic stuf for taking notes
	airplane surveys	can get crude estimates of population numbers and relative population abundance; biased against certain species	1-2 hours, but depend on the size of the area	high- cost of hiring an airplane	any open areas	Experience in quickly recognizing species	no	Binoculars, basic stuff for taking notes
	Traps	small and medium sized mammals	12 hours- leave out overnight	$20-50/trap	Any habitat where species occur	Skills on setting traps and selection of habitats	yes, trap does not kill animals	Tomahawk trap, Sherman traps, basic stuff for taking notes and collecting material
	Tracks	detecting mammal presence on land, riparian	1-4 hours- depends on search time	$0	Any habitat where species occur	Able to detect tracks and identify species from tracks	no	minimal- take photo or make plaster cast, basic stuff for taking notes
	transects	quantifies data if there are many sightings	1-5 hours	$0	Open habitat where species occur	Knowledge of establishing transects	no	binoculars if necessary, basic stuf for taking notes
Habitat type	field habitat assessment	morphology, characteristics, , evidence of disturbance, microhabitat structure, shoreline attributes, water depth	1-3 hours	low	Any habitat	training in field methods	no	tape measure, camera, substrate sampler, basic stuff for taking notes

Taxon	Method	Application	Field Time	Cost	Habitat	Required expertise*	Possibility of collecting ?	Equipment
	spatial data analysis	land use, vegetation type and distribution, shape of water bodies, water color, hydrologic regime, slope	variable, depending on data resolution and availability	variable-depending on data resolution and availability	Any habitat	knowledge of image processing and GIS	no	satellite imagery, aerial photos, digital elevation models, land cover, hydrography, geology, basic stuff for taking notes
	Manta tow survey	Very useful for rapid assessment of habitats	15 km of shoreline per day by team of 5 people	$50	Any clear water. Mainly shallow and mid-depth waters	Can be acquired in a day	No	Manta board, underwater paper an pencils

Annex III.

ASSESSMENT METHODS AND INDICES

Classification of assessment methods. A non-exhaustive and indicative list with references to reviews or key papers.

Assessment method	Application	References
Habitat assessment methods		
Habitat classifications		
EUNIS habitat classification	Marine	http://mrw.wallonie.be/dgrne/sibw/EUNIS/home.html
US NOAA habitat classification	Marine (Pacific and Caribbean)	http://biogeo.nos.noaa.gov/benthicmap/
Predictive systems		
Ecopath with Ecosim	Ecosystem effects of fishing, management applications	http://www.ecopath.org/
Physical-chemical assessment methods		
Bolton Index		Bolton et al. (1978)
Prati Index		Prati et al. (1971) [3]
Biological assessment methods		
Basic data		
Abundance of individuals of given taxa		Hellawell (1986) [4]
Total numbers of individuals (without identification)		Hellawell (1986)
Species richness		Hellawell (1986)
Diversity Indices		
Simpson's index		Washington (1984) [5]Hellawell (1986)
Kothé's Species Deficit		Washington (1984)
Odum's 'species per thousend'		Washington (1984)
Gleason's Index		Washington (1984)
Margalef's Index		Washington (1984) Hellawell (1986)
Menhinick's Index		Washington (1984) Hellawell (1986)
Motomura's geometric series		Washington (1984)
Fisher's 'alpha' (= William's alpha)		Washington (1984) Hellawell (1986)
Yules 'characteristic'		Washington (1984)
Preston's log-normal		Washington (1984)
Brillouins H		Washington (1984)
Shannon-Wiener H'		Washington (1984) Hellawell (1986)
Pielou Eveness		Washington (1984)
Redundancy R		Washington (1984)
Hurlbert's PIE encounter index		Washington (1984)
McIntosh's M		Washington (1984) Hellawell (1986)

Cairns Sequential Comparison Index (SCI)		Washington (1984) Persoone & De Pauw (1979) [6] Hellawell (1986)
Keefe's TU		Washington (1984)
Biotic indices, scores and multimetrics		
Saprobic systems		
Kolkwitz & Marsson's Saprobic System	bacteria, protozoa	Washington (1984)
Liebmann		Persoone & De Pauw (1979)
Fjerdingstad		Persoone & De Pauw (1979)
Sladecek		Persoone & De Pauw (1979)
Caspers & Karbe		Persoone & De Pauw (1979)
Pantle & Buck		Persoone & De Pauw (1979)
Zelinka & Marvan		Persoone & De Pauw (1979)
Knöpp		Persoone & De Pauw (1979)
Algae		
Palmer's Index	algae	Washington (1984)
Plants		
Haslam & Wolsley's Stream Damage Rating and Pollution Index		Nixon et al. (1996)
Plant Score		Nixon et al. (1996)
Newbold & Holmes' Trophic Index		Nixon et al. (1996)
Fabienne et al.'s Macrophyte Trophic Index		Nixon et al. (1996)
Macroinvertebrate systems		
Wright and Tidd's 'oligochaete indicator'	Oligochaeta	Washington (1984)
Beck's index	macroinvertebrates	Washington (1984)
Beak et al.'s 'lake' index	(lakes)	Washington (1984)
Beak's 'river' index	macroinvertebrates	Washington (1984)
Woodiwiss' Trent Biotic Index (TBI)	macroinvertebrates	Washington (1984)
Chandler's Biotic Score	macroinvertebrates	Washington (1984)
Biological Monitoring Working Party Score (BMWP)	macroinvertebrates	Metcalfe (1989) [7]
Average Score Per Taxon (ASPT)	macroinvertebrates	Metcalfe (1989)
Tuffery & Verneaux's Indice Biotique de Qualité Générale	macroinvertebrates	Persoone & De Pauw (1979) Metcalfe (1989)
Indice Biologique Global (IBG)	macroinvertebrates	Metcalfe (1989) AFNOR T90-350.
Belgian Biotic Index (BBI)	macroinvertebrates	De Pauw & Vanhooren (1984) [8]
Goodnights and Whitleys 'oligochaetes'	Oligochaeta	Washington (1984)
Kings and Balls' Index	tubificids, aquatic insects	Washington (1984)
Graham's Index	macroinvertebrates	Washington (1984)
Brinkhurst's index	Tubificids, Limnodrilus	Washington (1984)
Raffaeli and Mason's index	Nematodes, copepods	Washington (1984)
Sander Rarefaction method	polychaetes & bivalves (marine)	Washington (1984)
Heister's modification to Beck's index	macroinvertebrates	Washington (1984)
Hilsenhoff's index	macroinvertebrates	Washington (1984)
EPT-index	Ephemeroptera, Plecoptera,	

	Trichoptera	
Rafaelli and Mason's index		Washington (1984)
K135 Quality Index (Netherlands)	macroinvertebrates	Nixon et al. (1996)
Danish Fauna Index	macroinvertebrates	Nixon et al. (1996)
Jeffrey's Biological Quality Index (BQI)	macrobenthos (estuaries, coastal waters)	Nixon et al. (1996)
Biotic Sediment Index (BSI)	macroinvertebrates (sediments)	De Pauw & Heylen (2001) [9]
Fish		
Karr's Index of Biotic Integrity (IBI) (Fish index)	fish	Karr (1981)
Birds		
International Waterfowl Census on wintering birds	birds	Nixon et al. (1996)
"all in"-systems		
Patrick's histograms	algae to fish; exc. Bacteria	Washington (1984)
Chutter's index	all; exc. Cladocera & Copepoda	Washington (1984)
Similarity indices / Comparative indices		
Jaccard's index		Washington (1984) Hellawell (1986)
Percentage similarity (PSC)		Washington (1984)
Bray-Curtis dissimilarity		Washington (1984)
Pinkham and Pearson's Index		Washington (1984)
Euclidean or 'ecological' distance		Washington (1984)
Sorensen Quotient of similarity		Hellawell (1986)
Mountfort Index of similarity		Hellawell (1986)
Raabe's Comparative measure		Hellawell (1986)
Kulezynski's Coefficient of similarity		Hellawell (1986)
Czekanowski's Comparative measure		Hellawell (1986)
Sokal's Distance measure		Hellawell (1986)
Ecosystem health		
AMOEBA		Nixon et al. (1996), Ten Brink et al. (1991) [10]
Integrated or combined assessment systems		
TRIAD - Quality Assessment	BSI, ecotox., phys.-chem. (sediments)	Chapman et al. (1987)
EPA 's Rapid Assessment Protocols (RBP)		Barbour et al. (1992)
SERCON	Physical diversity, naturalness, representativeness, rarity, spp. richness	Boon (UK)

Annex IV
CASE STUDIES

Case study I: Inventory assessment

Inventory assessment of the Ecological Reserve West-Central Cayo Coco (marine area), North-Central Cuba (conducted by the Coastal Ecosystems Research Center, Minister of Science, Technology and Environment, Cuba).

Background: Cayo Coco is the fourth biggest island of the Cuban archipelago and a very important tourist destination with some 3 000 rooms currently. This cay is located in the central part of Sabana-Camaguey islands, North-Central of Cuba. As part of the objectives of a sustainable development project funded by GEF, the Governments of Cuba and Canada and Capacity 21, eight protected areas are under development on this group of islands. The Ecological Reserve West-Central Cayo Coco includes marine and terrestrial environments (about 30% of these ecosystems in Cayo Coco region) but there is a lack of in-depth information about the marine biological diversity of the area, which is critical for the establishment of this protected area.

Purpose: to assess major groups of marine biodiversity of the Ecological Reserve West-Central Cayo Coco.

Assessment Type: Inventory

Resources:
Time: Medium length (four weeks)
Money: Ample: $20,000 USD
Expertise: Experts for each selected taxa were available, with a total of 6 scientists from the Coastal Ecosystem Research Center.

Scope:
Taxa:
Marine flora
- *data:* species lists, new species, health, morphotypes
- *methods:* 40 sites sampled by visual census using quadrants.
- *analysis*: relative abundance

Corals and gorgonians
- *data:* species lists, new species, health, habitat characteristics, unique areas
- *methods:* 40 sites sampled by visual census using quadrants
- *analysis:* relative abundance, richness, density, comparisons of sampling sites, occurrence of special species

Fish
- *data:* species list, new species, distribution
- *methods:* 40 sites sampled by visual census using transects
- *analysis:* species list, richness, new species, relative abundance, distribution patterns, correlations between habitat, characteristics and abundance, ecological and geographical structure in assemblages

Geographical:
- Studies were focused on the marine area of the Ecological Reserve West-Central Cayo Coco.

Site selection:

Eight sites selected randomly were surveyed in each of the main habitats. They are: shallow reef drop-off (8-15 m); rocky pavement between reef drop-off and reef crest (4-6 m); front part of the reef crest (where *Acropora palmata* occurs, 2-3 m); rocky pavement back to the reef crest (1-2 m); reef lagoon (sandy bottom with patches of seagrasses).

Reference:

Hernández-Fernández, L., L. Clero y F. Pina. 2002. Inventario de la Reserva Ecológica Centro-Este de Cayo Coco. Resultado Científico del Centro de Investigaciones de Ecosistemas Costeros. 30pp.

Case study II: Species-specific assessment

Inventory assessment of the shark populations in the tourist area of Jardines del Rey, North-Central Cuba, (conducted by the Coastal Ecosystem Research Center, Minister of Science, Technology and Environment, Cuba).

Background: Fast tourism development has taken place in Jardines del Rey during the last 10 years due to the natural beauty of the area. One of the most promising sectors consists of marine activities, primarily diving and snorkeling. A Cuban-Canadian enterprise was planning to develop and isolated cay into a tourist destination and was concerned about the security of the tourists due to the abundance of sharks in the surrounding waters.

Purpose: to assess the sharks populations in the tourist spot Jardines del Rey, primarily in Cayo Paredón Grande

Assessment Type: Species-specific

Resources:
Time: Medium length (2 weeks)
Money: Ample: $2 000 USD (a desk study and the editing of a video)
Expertise: 1 ichthyologist for the report and 3 people to prepare the video.

Scope:
Taxa:
Sharks (few species recorded, nurse (*Ginglymostoma cirratum*), silky (*Carcharhinus falciformis*), reef (*Carcharhinus perezi*), great hammerhead (*Sphyrna mokarran*) and whale (*Rhincodon typus*))
Data:
fisheries data (species, zones and fishing gear), information gathered from interviews, field trips and video tapes about abundance and aggressive behavior of the sharks. No shark attack records are kept in Cuba.
Methods:
The desk study used existing information, which was compiled according to the objectives of this assessment (review of the data in the last 20 years from the books of catch of Fisheries Cooperatives, interviews, field work and video tapes)
Analysis:
With this very general information a document was prepared containing species list, abundance, distribution and observed aggressive behavior of the sharks. The document was complemented by a 10-minute video.
Geographic:
Jardines del Rey marine environment.

Reference:

Pina, F. 2001. Tiburones del norte de la provincia Ciego de Ávila. Resultado Científico del Centro de Investigaciones de Ecosistemas Costeros. 11pp.

Case study III: Change assessment

Effects of the mitigation measures after the impacts of natural events and human-based actions on marine environment in the Bahía de los Perros and Bahía de Jiguey, North-Central Cuba (conducted by the Coastal Ecosystem Research Center, Minister of Science, Technology and Environment, Cuba).

Background: A development project to build a causeway to join the island of Cuba with Cayo Coco (see Case study I) was carried out in the late 1980s. This causeway divided the Bahía de los Perros, a big lagoon (about 1 000 km^2) between the Cuba island and the cays located to the north, into two parts. It changed the hydrodynamics of the lagoon and the Bahía de Jiguey. During the same period of time, a very intensive drought took place in the region, which brought about an increase in the salinity of the lagoon. In order to counteract these changes, many mitigation measures were carried out in the 1990s. The purpose of the assessment was to determine whether the mitigation measures had been successful in improving environmental conditions in the lagoon.

Purpose: Determine if the mitigation measures have improved the environmental conditions of these lagoons.

Assessment Type: Change assessment

Resources:
Time: Medium length (four weeks)
Money: Ample, $25,000 USD
Expertise: Experts for each selected taxa and abiotic variables were available, with a total of 8 scientists from the Coastal Ecosystem Research Center.

Scope:
Taxa:
Marine flora
- *data:* species lists, health, morphotypes
- *methods:* 20 sites sampled by visual censuses using quadrants and samples from macrozoobenthic survey (see below)
- *analysis*: comparisons of sampling sites and with previous data, taking into account abiotic variables

Macrozoobenthos:
- *data:* species lists, abundance
- *methods:* 20 sites sampled using dredge
- *analysis:* relative abundance, richness, density, comparisons of sampling sites and with previous data, taking into account abiotic variables

Fish
- *data:* fisheries data (species, zones and gears)
- *methods:* review of the data in the last 20 years from the books of catch of Fisheries Cooperatives
- *analysis:* trend of catches (species, zones, fishing gear) , taking into account both, biotic and abiotic variables.
- *Note:* All this information was complemented with interviews of fisherman and local people.

Abiotic variables:
- Chemical (Total phosphorous and Nitrogen, Nitrates, Nitrites, Ammonium, Phosphates, Silicates, Oxygen Biological Demand and Oxygen Chemical Demand) and physical

features (pH, Dissolved Oxygen, Temperature, Salinity, Alcalinity, Transparency) of the water were measured and sediments were sample and examined (Determination of Organic Matter). Information about fresh water management was obtained from the agency in charge.

Geographical:

Studies were focused on the Bahía de los Perros and Bahía de Jiguey.

Site selection:

Previous and during the construction of the causeway both lagoon were surveyed several times. This assessment was carried out in most of these sites for comparisons through the time, though few new sites were selected taking into account current knowledge of the region.

Reference:

Pina, F., R. González de Zayas, L. Hernández-Fernández y M. Gómez. 2001. Monitoreo ambiental de los ecosistemas marinos del norte de la provincia de Ciego de Ávila. Estación de lluvia del 2001. Resultado Científico del CIEC. 2001. 16pp. 1 Tabla.

Case study IV: Indicators assessment

Using macroalgae, corals and fish as indicators of the Jardines de la Reina coral reef health, South-Central Cuba (conducted by several scientific institutions of Cuba and USA using the Atlantic and Gulf Rapid Reef Assessment protocol).

Background: Cuban marine environment is relatively well known due to many years of research. However, no comprehensive assessment of the state of the main marine ecosystems of the Cuban archipelago using standardized methodology had been carried out. The Atlantic and Gulf Rapid Reef Assessment Initiative has developed a protocol to rapidly assess coral reef ecosystems. This protocol has been successfully used in the wider Caribbean during the past several years. Besides the example discussed here, in the same year (2001), assessments in two of the other three main Cuban island groups were carried out.

Purpose: to assess the health of the Jardines de la Reina coral reef ecosystem.

Assessment type: indicator assessment

Resources:
Time: Medium length (four weeks)
Money: Ample: $75,000
Expertise: 13 scientists from Cuba and USA.

Scope:
Taxa:
Macroalgae

data: cover by morphotypes
methods: 53 sites sampled by visual censuses using quadrants.
analysis: relative abundance by morphotypes, comparisons of sampling sites there, Cuba and the Wider Caribbean.

Corals

data: species lists, number of colonies by species, cover by species, diseases, recent and old death), diameter and height of colonies, number of recruits, habitat characteristics
methods: 53 sites sampled by visual census using quadrants
analysis: relative abundance (density and cover), richness, health (diseases, death, diameter and height), recruitment, comparisons of sampling sites there, Cuba and the Wider Caribbean

Fish

data: species list, abundance and size of selected species
methods: 53 sites sampled by visual census using transects
analysis: species list, richness, new species, relative abundance, size structure, biomass, comparisons of sampling sites there, Cuba and the Wider Caribbean

Geographic:
Jardines de la Reina archipelago and its surroundings.
Site selection:

53 sites were selected using remote sensing imagery and the experience of guides in shallow reef drop-off (8-15 m) and front part of the reef crest (where *Acropora palmata* occurs, 2-3 m).

Reference:

Pina, F., P.M. Alcolado, L. Hernández-Fernández, R. González de Zayas, L. Clero, K. Cantelar y S. González-Ferrer. 2002. Estado de salud de los arrecifes coralinos de Jardines de la Reina. Resultado Científico del CIEC. 2002. 78pp. 16 Tablas, 24 Figuras.

Case study Va: Resource assessment

To assess the utility of the Exuma Cays Land and Sea Park, the Bahamas, as a marine fishery reserve (conducted by the Nature Conservancy and University of Miami, USA)

Background: The Exuma Cays Land and Sea Park is located in central Bahamas. The Park was established by the government of the Bahamas in 1958. Although many studies have been carried out in the Park, its utility as a marine fishery reserve was unknown.

Purpose: to examine the effectiveness of this Park as a marine fishery reserve, determining the spatial distribution of grouper assemblages and coral reef habitats inside and outside the Park and examining potential patterns of groupers larval transport and adult spillover to outside areas of the Park.

Assessment Type: **Resources Assessment**

Resources:
Time: Long (3 months).
Money: Ample
Expertise: Yes

Scope:
Taxa:
Benthic biota

data: inventory of species and coverage
methods: Visual censuses and collection of algae. Search for algae, sponges and benthic cnidarians species. Haphazard quadrants surveyed for coverage classes of substrata (sediment, rubble, hard reef) and lifeforms (seagrasses, algae, sponges, corals, octocorals). Point-intercept counts using quadrants for coverage of bottom (sediment, bare hard-bottom, algae, sponges, hard corals, octocorals and other benthic cnidarians), identifying the lifeforms to the lowest taxonomic level possible
analysis: species list, comparisons of species list and coverage between sampling sites inside and outside and among the four types of hard-bottom (cluster, ANOVAs, Jaccard coefficient, Percent Similarity Index, Spearman rank correlation coefficient)

Groupers

data: species composition, abundance and size
methods: Visual censuses using transects
analysis: species list, richness, abundance, size structure, biomass, comparisons between sampling sites inside and outside and among the four types of hard-bottom (ANOVAs, ANCOVAs, Spearman rank correlation coefficient). Total number of eggs produced by adult, female Nassau Grouper (*Epinephelus striatus*)

Geographic:

Northern cays of the Exuma Cays Land and Sea Park

Site selection:

74 sites were surveyed in four types of hard-bottom (patch reef, channel reef, windward hard-bottom, and fringing reef).

REFERENCE

Sluka , R., M. Chiappone, K.M. Sullivan and R. Wright. 1996. Habitat and life in the Exuma Cays, the Bahamas: The Status of Groupers and Coral Reef in the Northern Cays.The Nature Conservancy. 83pp.

Case study Vb: Resource assessment

Assessing the potential of Jardines del Rey coral reef ecosystems, North-Central Cuba, for sustainable use of aquarium fish (conducted by Institute of Oceanology, Minister of Science, Technology and Environment, Cuba)

Background: Trade of aquarium fish from tropical reef environment is a relatively new but profitable business. However, the activity could prove harmful for biological diversity and habitat health if it is not soundly developed. Knowledge about the standing stocks of the species extracted and the use of low-impact techniques are critical for the sustainable use of this sensitive resource. A resource assessment was carried out in order to investigate the feasibility of implementing a program on aquarium reef fish trade in Jardines del Rey.

Purpose: to assess the potential of Jardines del Rey coral reef ecosystems for sustainable harvesting of aquarium fish

Assessment Type: Resources Assessment

Resources:
Time: Medium (4 weeks).
Money: Ample: $25,000 USD
Expertise: Four Cuban ichthyologists were available.

Scope:
Taxa:
Small coral reef fish (small basses (Serranidae), basslets (Grammatiae), croakers (Scianidae), butterflyfishes (Chaetodontidae), angelfishes (Pomacanthidae), jawfishes (Opistognathidae), damselfishes (Pomacentridae), blennies (Labrisomidae and Blenniidae) and gobies (Gobiidae)

data:
Species composition, abundance

methods:
Visual censuses using transects

analysis:
Species list, richness, relative abundance, distribution patterns. Due to the lack of information about population dynamics and reproduction of the selected species, 10% of the population was proposed for extraction during the first year, using a zoned strategy, and taking into account abundance and distribution patterns. A monitoring program was carried out during the time the extraction took place in order to change this percentage if the level of use was under or over-estimated, and therefore ensuring the sustainable exploitation of these species. A protocol to catch the fish in an environmentally sound way was developed.

Geographic:
Jardines del Rey coral reef ecosystems, North-Central Cuba

Site selection:
40 sites (10 per habitat) were haphazardly selected and surveyed in shallow reef drop-off (8-15 m); rocky pavement between reef drop-off and reef crest (4-6 m); front part of the reef crest (where *Acropora palmata* occurs, 2-3 m) and rocky pavement back to the reef crest (1-2 m)

Reference:

Claro, R. y J.P. García-Arteaga. 1995. Evaluación del potencial de los ecosistemas coralinos de Jardines del Rey para el uso sostenible de los peces ornamentals. Resultado Científico del Instituto de Oceanología. 29pp.

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