

# Spatial Socio-economic Monitoring for Coastal Management (SocMon Spatial) Guidelines.

An addendum to the Global Coral Reef Monitoring Network (GCRMN)  
Socio-economic Manual for Coral Reef Management



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2018



**T**hese simple, user-friendly guidelines have been developed by the Centre for Resource Management and Environmental Studies (CERMES) at The University of the West Indies (UWI), Cave Hill Campus, Barbados, to assist coastal and marine resource practitioners and managers to apply the Spatial Socio-economic Monitoring for Coastal Management (SocMon Spatial) tool. They complement the regional SocMon guidelines and the Global Coral Reef Monitoring Network (GCRMN) Socio-economic Manual for Coral Reef Management and should be used together with them when developing any socio-economic assessment or monitoring programme.

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### Technical assistance and guidance

UWI-CERMES can provide technical assistance and guidance on the initiation and application of SocMon Spatial for socio-economic assessments and monitoring programmes. Contact Maria Pena at [maria.pena@cavehill.uwi.edu](mailto:maria.pena@cavehill.uwi.edu) for further information.

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Copies of (1) Spatial Socio-economic Monitoring for Coastal Management (SocMon Spatial) Guidelines (2018), (2) Socio-economic Monitoring Guidelines for Coastal Managers in the Caribbean (SocMon Caribbean) and any of the other region-specific SocMon guidelines and (3) the GCRMN Socio-economic Manual for Coral Reef Management can be downloaded from the global SocMon website ([www.socmom.org](http://www.socmom.org)).

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### Comments and feedback

Comments on SocMon Spatial and feedback on how it was applied would be most appreciated. Please send to Maria Pena.

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### Disclaimer

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### Cover photo

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# Preface

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These SocMon Spatial guidelines are intended to provide a step by step guide for integrating Socio-economic Monitoring for Coastal Management (SocMon) and Participatory Geographic Information Systems (PGIS) to assist SocMon practitioners in collecting spatial socio-economic data and information and for developing spatial outputs for coastal and marine site assessment and monitoring programmes. The guidelines are geared towards users with at least basic knowledge of, training in, and experience in applying, GIS and are expected to provide GIS practitioners with information necessary for applying participatory socio-economic monitoring methodologies to spatial planning and management systems.

The SocMon Spatial process intimately follows the six phases of SocMon. The guidelines are therefore meant to be used in conjunction with the [SocMon regional guidelines](#) and their companion GCRMN Socio-economic Manual for Coral Reef Management, the [GCRMN SocMon Manual](#).

The SocMon Spatial tool and these guidelines were developed in the Caribbean but are globally applicable to the other regions conducting SocMon. We encourage the other regions to adopt and adapt this tool to their region-specific contexts. For demonstration purposes, the SocMon Caribbean guidelines will be used for reference throughout these guidelines. Readers may find similar points of reference in each of the other regional SocMon guidelines.

SocMon is a global initiative of the Global Coral Reef Monitoring Network (GCRMN), the National Oceanic and Atmospheric Administration (NOAA) and IUCN World Commission on Protected Areas (WCPA-Marine). The initiative is being implemented at the global and regional levels with the goal of establishing socio-economic coastal and marine monitoring programmes globally at the site level. SocMon is a globally networked, regionally adapted, practical methodology of socio-economic monitoring for coastal management. Globally, seven regions are successfully conducting SocMon – the Caribbean, Central America, Brazil, South Asia, South East Asia, Western Indian Ocean and the Pacific Islands.

The Centre for Resource Management and Environmental Studies (CERMES) at The University of the West Indies, Cave Hill Campus, Barbados is the regional SocMon node for the Caribbean, promoting and supporting the use of SocMon through training and technical advice.

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# Introduction: Getting to Know SocMon Spatial

Socio-economic monitoring is integral to effective natural resource management. Socio-economic information provides us with an improved understanding of the social, cultural, economic and political conditions, contexts and motivations associated with the use of natural resources (Bunce et al. 2000; Bunce and Pomeroy 2003; Malleret-King et al. 2006; Hoon et al. 2008, Wongbusarakum et al. 2008a&b; Edwards et al. 2018). In 2000, the Global Socio-economic Monitoring for Coastal Management ([SocMon](#)) Initiative was established out of the need for collecting socio-economic data at coastal sites. SocMon is a global initiative establishing coastal and marine socio-economic monitoring programmes at coastal management sites. Seven regions globally are successfully conducting SocMon (SocMon is referred to as SEM-Pasifika in the Pacific Islands).

Historically, rapid development, overpopulation and heavy resource consumption, have propagated a wide range of socio-economic and environmental conflicts and threats that affect sustainability. These issues are a result of interacting anthropogenic and natural pressures that present challenges requiring prudent and adaptive management. This necessitates a comprehensive understanding of the socio-economic features that interact with components of the natural environment. The methodology provided by the Global Socio-economic Monitoring Initiative for Coastal Management (SocMon) provides a standardised but flexible methodology for the collection, analysis and presentation of this vital socio-economic data and information for resource management.

The resulting data can be translated and applied in a variety of ways to enhance resource management. SocMon provides relevant information for enhancing the understanding of the socio-economic context within which management strategies are being undertaken. It aids in assessment of present conditions and tracking of trends. It can also assist education and improve stakeholder capacity for adaptive management. All of these benefits highlight the importance of SocMon as a tool for the enhancement of coastal, marine and fisheries management.

Due to the dynamic and multifaceted nature of the SocMon methodology, new and innovative ways of using and communicating the data and information collected are constantly being explored. In an effort to produce new and engaging outputs, the SocMon Spatial tool has been developed.

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What is  
SocMon Spatial?

SocMon Spatial is a tool developed in 2013 by the Centre for Resource Management and Environmental Studies (CERMES), The University of the West Indies Cave Hill Campus, Barbados, the regional SocMon node for the

Caribbean. It was developed to complement the existing SocMon methodology by providing an alternate means of storing, analysing and representing the socio-economic data collected. SocMon Spatial merges the robust power of a Participatory Geographic Information Systems (PGIS) approach with the analytical framework provided by the SocMon methodology.

In recent years, the use of GIS coupled with participatory approaches has emerged as a novel science known as participatory GIS. A PGIS approach is both in terms of the participatory processes involved in the development of the conceptual framework as well as the construction of an appropriate, locally-relevant product (Baldwin 2012). Accordingly the process of developing of a PGIS should result in the production of information that is both understandable and accessible to stakeholders; thereby facilitating transparency, capacity-building and collaboration in decision-making. Moreover by promoting the participation of stakeholders in the development of a technical representation of spatial knowledge allows for learning and understanding of the linkages between marine resources and human communities required for ecosystem approach to management and planning. One of the main aims of SocMon Spatial is to allow for the visualisation of socio-economic (locational) data that may be of use for decision-making.

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### Who is SocMon Spatial for?

The target audience for SocMon Spatial, much like the Global SocMon Initiative, is primarily coastal and marine resource practitioners and managers (MPA managers, fisheries managers, field staff). This includes:

- Researchers
- Government authorities
- Non-governmental organisations
- Local people and community organisations

However, it can also be beneficial to other stakeholder groups, including secondary audiences, such as:

- Academic institutions
- International and regional organisations
- Communication

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### Why use SocMon Spatial?

SocMon Spatial is a tool that can guide better decision-making. Spatial analysis allows the combination and simplification of different types of complex data in an effort to make it understandable for various users. It provides users with insight into the spatial and temporal considerations associated with the socio-economic aspects of natural resource management. This is enabled through a flexible set of guidelines for merging PGIS techniques and SocMon. SocMon Spatial is intended to provide a suite of PGIS tools that can be used to store, manage, analyse, transform and visualise socio-economic data and information as well as to combine and compare other types of information within a SocMon database. For example, biophysical data such as flood zones can be compared with livelihood data collected through SocMon to determine areas of high vulnerability.

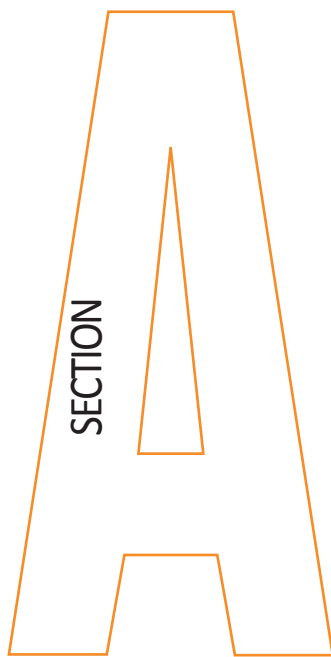
The SocMon Spatial process intimately follows the six phases of SocMon –

## What is the SocMon Spatial process?

Preparatory Activities, Reconnaissance and Planning, Data Collection and Observation, Data Analysis and Validation, Key Learning and Communication, and Decisions and Adaptive Management. See Bunce and Pomeroy (2000). The guidelines are therefore meant to be used in conjunction with the SocMon regional guidelines and their companion GCRMN Socio-economic Manual for Coral Reef Management (GCRMN SocMon Manual). The SocMon Caribbean guidelines are referenced throughout these SocMon Spatial guidelines for demonstration but readers will find similar points of reference in each of the other regional SocMon guidelines for Brazil, South Asia, Southeast Asia, Western Indian Ocean and the Pacific Islands (Hoon et al. 2008; Wongbusarakum 2008; Mallert-King et al. 2006 and Bunce and Pomeroy 2003b)

### Companion references:

- Bunce L., P. Townsley, R. Pomeroy and R. Pollnac. 2000. *Socio-economic Manual for Coral Reef Management*. Australia: Australian Institute of Marine Science. 251pp.
- Bunce, L. and R. Pomeroy. 2003a. *Socio-economic Monitoring Guidelines for Coastal Managers in the Caribbean: SocMon Caribbean*. Australia: World Commission on Protected Areas and Australian Institute of Marine Science. 88pp.
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- Hoon V., G. Sriskanthan, P. Townsley, B. Cattermoul, L. Bunce, and B. Pomeroy. 2008. *Socio-economic Monitoring Guidelines for Coastal Managers of South Asia, SocMon South Asia*. IUCN/CORDIO.
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- Wongbusarakum, S., B. Pomeroy, C. Loper, C. Vieux, M. Guilbeaux, A. Levine and C. Bartlett, 2008. *SEM-Pasifika: Socio-economic Monitoring Guidelines for Coastal Managers in Pacific Island Countries*. Secretariat of the Pacific Regional Environment Programme, Apia, Samoa, 139pp.



## A1: Variable selection



SocMon has over 70 variables that can be applied to any spatial resource management scenario. The majority of variables are shared across all SocMon regions but there is slight variation with additional variables used and sometimes shared by regions

### What can the variables be used for?

#### To monitor:

- Management effectiveness
- Demographic trends
- Resource use
- Environmental impacts

SocMon Spatial can be used to incorporate any SocMon variable into a GIS

# Preparatory Activities

**P**reparatory Activities is the first phase of initiating a SocMon assessment or monitoring programme. It is during this phase that the scope of the assessment or monitoring programme is established and comprises defining and developing the goals and objectives for measurement, determining the extent of the study area, identifying and consulting with the coastal management stakeholders, developing the SocMon team, and outlining the process for conducting the SocMon. Subsequent to these steps, SocMon variables relevant to goals and objectives are chosen for measurement

*Refer to GCRMN SocMon Manual Chapter 1, pages 19 to 51.*

SocMon provides a suite of 60-67 socio-economic variables (Bunce and Pomeroy 2003a) categorised according to:

- Community Level Demographics;
- Community Infrastructure and Business Development;
- Coastal and Marine Activities
- Governance
- Household Demographics
- Attitudes and Perceptions
- Material Style of Life.

*See pages 18-19, SocMon Caribbean guidelines.*

There are also an additional ten variables (Wongbusarakum and Loper, 2011) specifically designed for measuring changes due to climate change. Due to the flexibility of the SocMon methodology, new variables may be created to measure socio-economic characteristics and conditions that are specific to the objectives of a SocMon assessment or monitoring programme but are not covered by the original set of SocMon variables.

Three criteria generally guide the variable selection process: the goals and objectives of the assessment or monitoring; the general importance to data collection; and site-specific conditions. However, a fourth criterion is used for the application of SocMon Spatial variable selection: spatial representation significance and suitability. Variables should be selected based on suitability for representation and importance of spatial considerations to management over time. This spatial application is intended to enhance the SocMon methodology through add-on value. As a result, the GCRMN SocMon Manual (Bunce et al. 2000) and region-specific guidelines (Bunce and Pomeroy 2003a&b; Malleret-King et al. 2006; Hoon et al. 2008; Wongbusarakum et al. 2008) should be utilised as the primary basis for informing SocMon Spatial variable selection. The developed criterion should be used to supplement the



existing variable selection guidelines. The SocMon guidelines suggest links between the monitoring goals or objectives and the variables.  
 See pages 20-23, SocMon Caribbean guidelines.

## A2: Understanding SocMon Spatial Variable Categories

### A2.1: Feature variables

**!**

**The SocMon Spatial Selection Criterion:**  
 Variables should be selected based on suitability for representation and importance of spatial considerations to management over time. This criterion is meant to help researchers choose variables which can be easily mapped and are of particular importance to their management objectives.

The SocMon Spatial process depends heavily on the relationships between the variables chosen. As a result, careful analysis of the variables and their characteristics is essential. SocMon Spatial categorises variables into two groups-**Features** and **Attributes**.

These variables represent individual elements of the study area. The entire area may comprise many different features, but each feature is represented by a digital symbol. These are visually represented as points, lines, and/or polygons which show their geographical location on the map. Activity and threat features can be visually depicted on a map using points, lines and/or polygons.

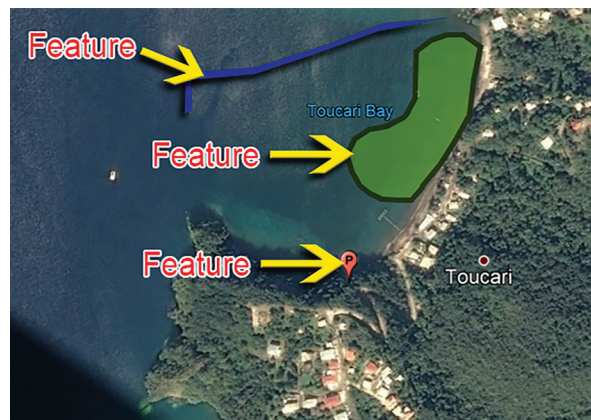


Figure 1 Map showing features and attributes

**Feature variables** are collected via secondary data review or analysis, surveys or key informant interviews. However, key Informant interviews are recommended as the best way to collect rich data with lots of attributes and accurate spatial descriptions.

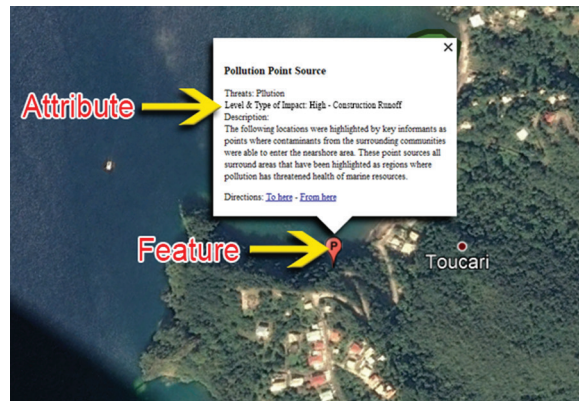
Features are represented using vector data

- Points:
- Lines:
- Polygons:

Figure 2 Vector model representation

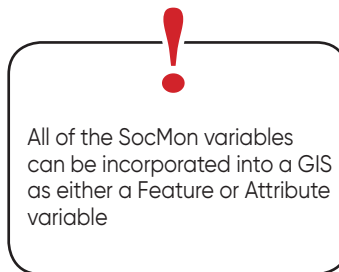
### A2.2: Attribute variables

**Attribute variables** are descriptive. These variables include the characterising information that helps users to define the features they are tied to. They are not visually depicted separately, but are linked to features as text, photos and/or charts to help with the interpretation of the feature variables. For example, variables such as *K20: Levels and Types of Impact*, can be included as attribute variables to describe a specific aspect of the pollution feature associated with the *S17: Perceived Threats* feature variable.



**Figure 3 Map highlighting attribute Information**

The data for these attribute variables are collected via secondary data review or analysis, surveys or key informant interviews and are recorded and stored as text data. Much of the data collected through SocMon interviews may be categorised as attribute data. All of these data can be assigned to the associated features that are displayed on the map.



### A3: Selecting SocMon Spatial Variables

There are two main steps associated with the selection of appropriate SocMon Spatial variables for measurement and monitoring. Using a fisheries management scenario as an example, these steps are outlined below.



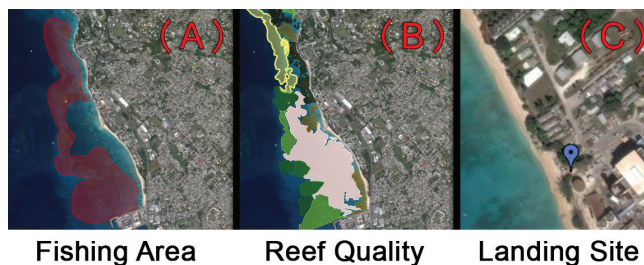
### Step 1

From the set of SocMon variables, first choose the variables that represent the management components that are to be represented as primary features of the SocMon study site.

#### Example:

If improved fisheries management is a monitoring goal certain aspects must be visualised spatially. These include (See Figure 4):

- A: Where people fish - spearfishing grounds
- B: Where key habitats are located - reef habitat
- C: Where fisheries infrastructure is located - landing sites



**Figure 4** Maps highlighting features

These characteristics can all be represented as feature variables. On their own, feature variables may only provide limited information about the management goal in question. As a result, more descriptive information may be required for meeting specific management objectives.

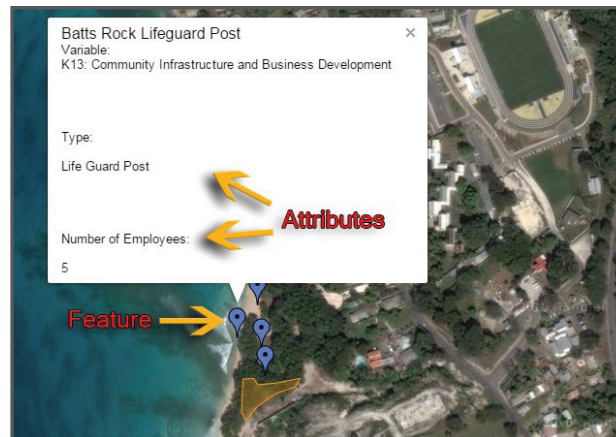
### Step 2

Based on the monitoring goals and objectives, attributes that will be used to describe the features of interest must be determined. **Descriptive attribute** information can be obtained from any of the SocMon variables. See Table 1.

**Table 1. Features, their associated attributes and related SocMon variables**

Feature Information	Related attribute information	Related SocMon variables
Where people fish	The types of fishing and the gear used	K19 – Use patterns K16 – Types of use S12 – Household uses
Where key habitats are located	Health of habitat and how key habitats are being impacted	K19 – Use patterns K20 – Level and types of impacts S16 – Perceptions of resource conditions S17 – Perceived threats
Where fisheries infrastructure is located	Who is responsible for this infrastructure	K13 – Community infrastructure and business development

These variables can provide quantitative data and contextual information that can be analysed, visualised and applied for improved management and decision making. Examples of both feature and attribute information are shown on the following map (Figure 5).



**Figure 5 Example of a practical feature/ attribute**

**A4:**  
**Variable Packaging**

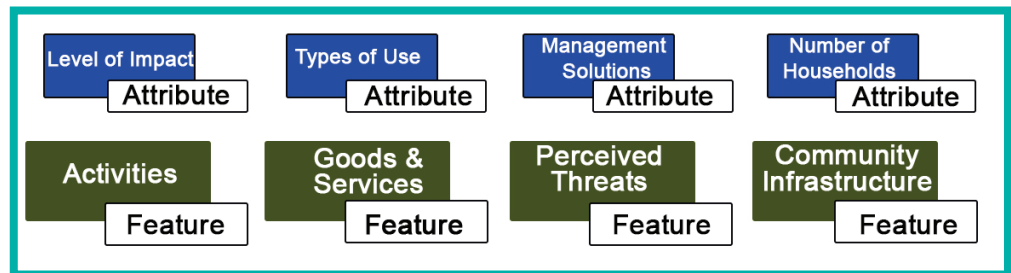
- The previous variable selection and categorisation activities help to:
- Identify the variables needed to meet project objectives, and;
  - Provide a better understanding of how variables are associated with each other.

The linkages between variables can help in the creation of a layered structure of variable options. This allows the development of an assortment of packaged variables for each monitoring goal and objective identified. These variable packages are essential for informing future SocMon Spatial activities.

**A4.1: How variable packaging works**

For example, variable *S15: Non-market and Non-use Values* is intended to collect perceptions of the values of specific goods and services. However, this variable may not be adequately represented spatially, without representing *K15: Goods and Services* as a feature. As a result, these two variables should be grouped.

Grouped variables can be linked to specific monitoring goals and objectives thus providing a framework to guide the SocMon Spatial analysis and outputs. The SocMon Caribbean guidelines (and all region-specific SocMon guidelines) suggest links between monitoring goals or objectives and variables and suggest variables that should be measured and monitored together. Similarly, the SocMon Spatial variable packages follow the groupings given in the SocMon Caribbean guidelines, but require variables to be highlighted and then linked as associated feature and attribute variables.



**Figure 6 Examples of variable links for geodatabase structure**

! Features identified by respondents are included in the geodatabase by digitizing field maps. Digitizing in GIS is the process of converting geographic data either from a hardcopy or a scanned image into vector data by tracing the features. Digitization explained in Section D

Variable packaging is a necessary step that helps to guide the development of the SocMon Spatial database and the structure of later phases of the monitoring programme. The steps include:

**Step 1: Link the variables**

Once all of the relevant variables have been selected (according to the goals and objectives for monitoring), the linkages between them must be determined. Here is how it's done:

Based on the variables selected, determine which ones will be visually represented. For example, if one of the monitoring goals or objectives is improved management of coral reef habitat, then the location of reefs of particular interest should be visually represented. Therefore variable *K15: Goods and Services* may be chosen as a feature to highlight the coral reef habitat and other resources in the area.



## Step 2: Add the associated attributes to the feature selections

Based on the feature variables selected, the information associated with them may be included as attribute data. For example, for the purposes of monitoring, it may be necessary to gain some reef condition or reef health information. Therefore, variables such as K20: *Levels and Types of Impact* would be included as an attribute variable that is linked directly to the feature variable K15: *Goods and Services*.

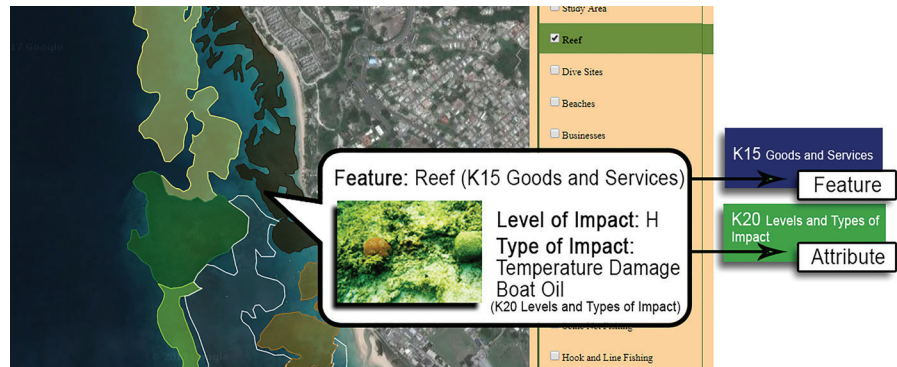


Figure 7 Infobox showing descriptive information from attribute variables

### A4.2: The importance of variable packaging

Packaging of variables forms the framework that will guide shapefile and geodatabase development in subsequent phases of the SocMon Spatial component of any SocMon assessment or monitoring programme. Feature variable data will be digitised into the mapping software of choice, while attribute variables will be included in the attribute tables or information windows that are linked to the digitised features. As a result, this will guide mapping exercises to focus on gathering locational information for the selected features and a wealth of associated attribute data through key informant and survey questions.

### A5: Identifying the SocMon Spatial Team

**!** Ideally, a team of three persons that are familiar with GIS is recommended. However, the presence of ONE practitioner with access to two participants who can be trained in SocMon Spatial development and output methods would enable efficient integration of your SocMon project data into a GIS.

SocMon should be carried out by multi-disciplinary teams with a wide range of skillsets to fill the roles required for a successful SocMon monitoring programme. SocMon Spatial follows the same team selection criteria but includes one additional component. SocMon Spatial requires that teams include at least one GIS practitioner due to the data analysis and geodatabase development requirements.

Having a GIS practitioner on the team ensures that datasets and geodatabases are properly developed. All SocMon team members will receive some training on PGIS methodologies for the data collection phases of SocMon Spatial, but only select persons of the SocMon Spatial core, require specific training for the data analysis and geodatabase development components of the SocMon Spatial process. Further guidance on PGIS capacity development for SocMon Spatial will be necessary as the methods evolve.

## Planning and Scoping

This second phase within the SocMon process sets the stage for collecting the data for the socio-economic assessment or monitoring program. It builds on the information collected during the preparatory phase, is done by the SocMon team and involves compiling relevant secondary data, reviewing and analysing the quality of these data, conducting a scoping visit of the study area and developing a workplan for the data collection phase. *Refer to GCRMN SocMon Manual, Chapter 2, pages 53-82.* Throughout this phase, the SocMon team can modify and adapt the objectives, stakeholder list, study area and sites, and variables for monitoring based on new information gathered.

### B1: Scoping the Study Area

Scoping or reconnaissance is arguably the most important component of the SocMon Spatial process. It is conducted to improve the understanding of socio-economic conditions and characteristics of the study area as well as to improve the understanding of the spatial interrelationships that exist. The reconnaissance approach taken when implementing SocMon Spatial should be similar to that undertaken in a standard SocMon study (*Chapter 2, pages 53-82, GCRMN SocMon Manual*) but researchers must focus on the spatial relationships between features. This spatial awareness helps to facilitate the data collection and geodatabase development processes. During this phase, the identification of additional stakeholders and key informants (not previously identified in the preparatory activities phase) is necessary to guide future data collection activities. During reconnaissance, the types and proportions of stakeholders to be targeted during the mapping exercises are determined.

#### B1.1: Components of a SocMon Spatial reconnaissance visit

Reconnaissance is an activity geared towards gathering a wide range of preliminary contextual data in a short space of time. This phase of SocMon Spatial involves three components:

- Identification of spatial characteristics and relationships
- Preliminary collection of primary spatial data
- Identification of SocMon Spatial stakeholders

#### *Identification of spatial characteristics and relationships*

The identification of the study site's spatial characteristics is the first step in the reconnaissance phase. This helps the researcher gain a better understanding of where features are and how they interact with each other within a defined space. During reconnaissance visits the researcher may collect useful information for the production of SocMon Spatial basemaps.

Oftentimes researchers may be familiar with individual components of a particular sector, but how they interact with the various users, processes and

resources within a given area may not be obvious. As a result, this type of assessment can reveal information that helps to focus the SocMon Spatial process on key components for meeting monitoring objectives.

**Example:**

The SocMon Spatial component may be focussed on fisheries management and have an objective to determine the impact of small-scale fisheries on nearshore reef habitats.

In this scenario the researcher may understand which stakeholders are involved within the fisheries sector but may not be aware of how their activities interact with tourism and industrial activities in the area. The combined effects of these activities may have very unique impacts on specific areas and create high-impact hotspots that are unique to the area in question.



**Figure 8 Map showing overlapping activities**

*Preliminary collection of primary spatial data*

The collection of preliminary spatial data is very beneficial for subsequent SocMon Spatial assessment activities. Although, secondary data collection is a very important aspect of the preparatory activities for both SocMon and SocMon Spatial, gathering accurate data that is tailored specifically to SocMon Spatial can be a difficult task. As a result, certain key data points should be collected early in the assessment and used as:

- Reference points for future data collection and analysis,
- Baseline primary data for assessing secondary data quality, and
- Initial data for feature and field map development.

Collection of primary spatial data is a necessary step for a spatially-focused assessment because it:

- Collects accurate locational data without relying on unconfirmed secondary data, and
- Reduces the amount of spatial information needed in subsequent mapping exercises.

*Identification of stakeholders*

During the reconnaissance phase stakeholders are identified based on their interactions with each other and the resources present within the area. Stakeholder selection for SocMon Spatial targets individuals that are actively associated with the resources and/or activities of interest or relevance.



### Stakeholders are not made equally

Every stakeholder is different. They may have very different demographic characteristics and engage in varying activities in various different ways. These differences help us to determine what role they may play in the SocMon assessment or monitoring programme.

**Primary Stakeholders:**

people who directly depend on the reef for a living and who make direct use of the reef and its resources (e.g. fishermen, dive operators);

**Secondary Stakeholders:**

people who do not use the reef and its resources directly, but make use of products or services from the reef (e.g. fish traders) or whose actions may affect the reef (e.g. upstream farmers)

Stakeholders should be classified, as either primary or secondary, based on:

- Their level of use of resources, impact on resources and resource users within the study area and
- Their length of stay and influence within the study area.

An understanding of stakeholder classification will help to:

- Determine stakeholder group sample size and mapping exercise strategies, and
- Focus areas for SocMon Spatial project database development.

Key informants with an intimate knowledge of the area’s spatial characteristics are required. Key informants targeted for data collection should therefore be living or regularly working in the area.

In scenarios where additional information about stakeholders and their activities is required, it may be necessary to conduct some preliminary stakeholder interviews. These interviews should gain information necessary for conducting the stakeholder classification exercise and give insight into important aspects of the project, but should be limited to a few short questions.

Such questions could be:

1. Do you fish (or engage in other activities) in the area?
2. How long have you lived or worked in the area?
3. Who is in charge of (specific resource or activity) in the area?
4. Who should we talk to if we need to find out more about (specific resource or activity)?

Lengthy preliminary interviews can make key informants hesitant to participate in interviews being conducted in later phases of the study; therefore they should be avoided. Short preliminary interviews can be used to inform stakeholders of upcoming project plans and prepare them for what is in store while building an informal relationship that can help to build trust.

**B1.2: Important steps in a SocMon spatial reconnaissance survey**

**!**  
 The SocMon Manual's reconnaissance survey guidelines state that, "The assessment team should use common sense, experience and knowledge of the area to determine how to adopt the steps during reconnaissance of the area." taken in surveying the area. (Bunce et al. 2000)

Based on the researcher's knowledge of the area, the level of assessment may vary. Researchers that are very familiar with the activities and stakeholders within an area may skip the preliminary stakeholder interviews and/or full spatial reconnaissance. It may be necessary to confirm the locations of key features and infrastructure by obtaining precise GPS locations, but if the researcher knows the area intimately it may not be necessary to analyse the spatial relationships with other features.

SocMon Spatial reconnaissance is arguably the most important component of the planning and scoping phase as it guides other steps in this phase (e.g. secondary data collection), steps in subsequent phases (e.g. mapping exercises in field data collection and observation), and feeds back and checks steps in the preceding preparatory activities phase (e.g. key informant selection). Steps in spatial reconnaissance are outlined below.



**Step 1: Developing a reconnaissance checklist**

From an understanding of the study area and any secondary data gathered, a list of features, stakeholders, threats, conflicts and key infrastructure should be compiled to guide scoping activities. When developing the checklist, keep monitoring goals and objectives in mind. This list should be as comprehensive as possible and all locations that are related to a specific resource or activity should be identified and recorded.

**Example:**

If reducing beach resource conflict is a project goal or objective, the spatial checklist may look like this:

**!**  
 Spatial reconnaissance checklists help to streamline scoping efforts so that time in the field is focused on gathering information to inform SocMon Spatial data collection efforts.

**Table 2 Spatial reconnaissance checklist**

Feature (What are we looking for?)	Location (Where is it?, What is it close to?)	Key informants (Who can tell us about it?, Who uses this space?)
Activities		
Watersports	West of storm drain and hotel	"Flash" (nickname), jet ski and boat operators
Vending	13,11,07,29 – 59,38,18,49*	Jane Doe
Resources		
Sandy Bay	South Hoeltown to North Sandpiper	Visitors and locals for recreation and business

\* Activities may also be represented by GPS waypoints, as seen above for the vending feature



## Step 2: Recording locations of features and characteristics

Based on the reconnaissance checklist, look for each of the points on the list and record the location using a GPS device (or a satellite map/cellular phone), making notes of the observed characteristics and their spatial relationships. The spatial reconnaissance checklists can be tailored to focus on any of the objectives of the SocMon assessment or monitoring programme, but in order for them to be effective, the researchers must:

- Ensure that locational information is included in the reconnaissance survey notes either with specific (GPS coordinates) or contextual location descriptions.
- Highlight the spatial relationships between resources, their uses and users.

These parameters can provide quantitative data and contextual information that can be analysed, visualised and applied for improved management and decision-making.

## Step 3: Identification and classification of stakeholder groups

Use the checklist from Step 1 and the information from Step 2 to identify relevant stakeholder groups and classify them as primary or secondary by answering these three questions:

- Is their base of operation (or do they live) directly within the study area, are they remotely located or do they just pass through the study area?
- What is their level of activity and impact on the study area?
- What is their organisational influence within the study area?

During this step, preliminary stakeholder interviews may be conducted to gain more information about the activities, threats and stakeholder groups in the area. It is also an ideal time to validate some of the secondary data that may have been previously collected.

## Step 4: Data and information storage

The notes collected during the reconnaissance surveys must then be stored in a safe location and digitised so that it can later be used to:

- Develop site maps,
- Inform mapping exercise questions, and
- Be included as features in the final dataset.

## B2: Secondary Data Collection

---

The collection of preliminary spatial information and secondary data provides a foundation of knowledge to be used in subsequent phases of the assessment. Secondary data collection for SocMon Spatial follows the same process as recommended in the GCRMN SocMon manual. However, for spatial secondary data scoping, two types of information are gathered - contextual data and spatial data.

### B2.1: Gathering secondary contextual data

The contextual data provide background information as well as event and timeline details and is made up of the usual secondary data that is collected for any type of monitoring assessment, including:

- Scientific articles
- Newspaper articles
- Statistical data
- Maps and charts

However, for SocMon Spatial components of SocMon assessments, certain spatial considerations must be considered when gathering these data. For each set of approved secondary data, researchers should search for spatial information included in the data or determine the spatial extent that it is linked to.

### B2.2: Gathering secondary spatial data

This type of data is essential for geospatial analysis that can inform various types of planning and management, including: physical and spatial planning, threat analysis, site monitoring and even land use zoning.

Gathering secondary spatial data can be a difficult task as spatially explicit data are less common than standard quantitative or qualitative datasets. Through online searches, teams can find valuable spatial data, however some key sources for local spatial that cannot be found online are:

#### Government Offices

- Physical Planning Department
- Lands and Surveys Department
- Environmental Management Departments
- Agricultural and Rural Planning Departments
- Forestry Departments
- Statistical Departments
- Coastal /Marine Management Departments

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#### Academic Institutions

- Geography and Geophysical Science Departments
- Social Science Departments
- Environmental Departments

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#### Non-governmental Organisations

- Surveying & Geomatics Consultancies
- Meteorological Institutes
- Tourism Authorities
- Environmental NGOs
- Dive shops
- Sailing Associations and Sportfishing Associations



### Questions for guiding SocMon Spatial secondary data collection:

- Is this data specific to a particular location within the study area?
- Can spatial management strategies be used to manage the impacts?
- Can this data be represented spatially?

### B2.3: Secondary data quality control

### Quality assurance for contextual data

Secondary spatial data collection provides supporting information that can help the researcher gain a deeper understanding of the recorded legislative, management and historical context at the study site. This helps the SocMon team to focus their inquiry in later phases of the project. For example, if location-specific data can be sourced for an existing threat, the way in which policy and legislation may affect the management of key areas within the site being investigated may be determined.

Careful secondary data analysis is always a necessary component for any type of monitoring study. This step helps the monitoring team:

- Gain a better understanding of the area and its characteristics,
- Determine gaps in knowledge,
- Avoid duplication of effort, and
- Build on existing knowledge.

Since secondary information is of considerable importance for these SocMon Spatial assessments, the data collected must be of an acceptable quality. This requires strict quality control standards to be developed for both:

- Contextual and attribute data
- Spatial or feature data

All of the quality assurance tenets discussed take all other data quality consideration into question but are focussed primarily on the spatial quality.

To ensure that the secondary information collected provides valuable contextual and/or attribute data, the spatial and temporal considerations surrounding this contextual data must be analysed.

Each dataset can provide information about:

- The type of data (What?)
- Temporal and spatial characteristics (Where and When?);
- Data collection methods (How?);
- Executing agency (By Whom?);

Carefully analysing the secondary data to find this information can help the users to determine the data's suitability for use in spatial datasets. Once their suitability has been determined, the data can be effectively linked to georeferenced features within the SocMon Spatial database and improve the understanding of the features represented. However, without these secondary contextual data, all contextual data would have to be collected from respondents during subsequent mapping exercises. Therefore, adequate secondary data can reduce the amount of primary data collection required during the later phases of the assessment or monitoring activity.

### Quality assurance for spatial data

Quality assurance for GIS datasets obtained during this phase of the SocMon Spatial process includes a review of the metadata and rapid spatial validation exercises; both of which are explained below.

#### Metadata review

The metadata fields must be analysed to ensure that the necessary spatial reference information is included and that information regarding the shapefile development standards and process is also available.

To ensure that the GIS datasets used in SocMon Spatial assessments are accurate, metadata should be analysed for information on:

- Temporal characteristics - what dates are referenced?, when were the data collected?,
- Data collection methods - how the data were collected e.g via remote sensing,
- Shapefile development standards - standards associated with the relevant software,
- Projection information - global coordinate system, spatial projections,
- Authorship and institutional details, and organisation, name of investigators etc. and,
- Locational accuracy - degree of accuracy.

#### Rapid spatial validation

Data quality is of considerable importance to any SocMon Spatial assessment therefore the data collected must be validated. Spatial validation exercises may include site visits to verify the accuracy of the spatial location of GIS data by:

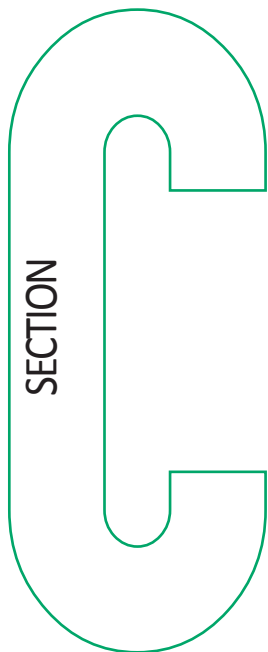
1. Gathering coordinates and location descriptions of at least three key features from the shapefiles and/or any other spatial data collected.
2. Finding these coordinates using a GPS device and verifying the locations of features at these points.

Once the data have been spatially verified and assessed for quality assurance, data specific to the study area and time-frame can then be extracted from each dataset.



Nogueras-Iso, J., M.A. Latre, R. Béjar, P.R. Muro-Medrano and F.J. Zarazaga-Soria. 2012. "A model driven approach for the development of metadata editors, applicability to the annotation of geographic information resources." *Data and Knowledge Engineering* 81-82(November): 118-139.

Yalcin, G. and S. Bakici. 2008. "Metadata portal for maps in Turkey. *IAPRS* 37(4): 1605-1611.



# Data Collection and Observation

**A**fter completing the first two phases of the SocMon process, the SocMon team is now ready to begin data collection according to the guiding principles for field data collection. The GCRMN SocMon Manual clearly outlines the methodology for SocMon data collection (*Chapter 3, pages 83-156*), but these guidelines are specifically focused on explaining the techniques used for collecting SocMon Spatial data. The SocMon Spatial guidelines are based on PGIS methodology that is used for spatial planning and resource management (Rambaldi et al. 2005, Baldwin 2012, Mercer et al. 2012).

The data collection phase enables team members to gather spatial information that cannot be easily extracted from secondary information. This phase allows for the collection of local knowledge and/or undocumented information which may be essential for management within a dynamic and multifaceted resource use environment. SocMon Spatial data collection allows the capture of:

- The spatial characteristics of stakeholder perceptions;
- An understanding of spatial interactions and conflicts; and
- More accurate representation of use patterns for finer resolution space-use data.

## C1: Guiding Principles for PGIS Data Collection

The techniques discussed here are specifically targeted at gathering spatial information, but they are also designed to facilitate participatory data collection of any kind. Participatory approaches can be effective in strengthening capacity by improving the knowledge base, through the collection of traditional and local knowledge. Also, PGIS can help legitimise and increase the accessibility of local knowledge. PGIS can be used to integrate this collected local knowledge into a GIS and merge it with qualitative data that can be interpreted to inform decision-making for both the relevant communities and resource managers.

The key principles of PGIS include: equity, inclusion, transparency, collaboration and accountability. These principles must be applied throughout the process for completion of a truly effective PGIS project. These principles provide a framework for the integration and development of accurate and accessible information for both stakeholders and decision-makers. A major component of PGIS is the ownership and accessibility of the information after the project is completed.





The Participatory Geographic Information Systems (PGIS) practice developed from using participatory learning and action with geospatial technologies to allow for the spatial representation of local and scientific knowledge by stakeholders. It is focused on:

**Equity:**

the quality of being fair and impartial.

**Inclusion:**

Including and embracing all; not excluding any particular group(s) of people:

**Transparency:**

The ways in which decisions are made; Are they in the interest of the public? Are they seen to be in their interest and is there scrutiny of their actions?

**Collaboration** - Working together to meet shared goals and objectives. Do people work as a team to meet agreed targets? Are there shared processes and outputs of knowledge creation?

**Accountability** - Creators are held to producing accurate and transparent representations of a shared reality.


## C2: SocMon Spatial Data Collection: Mapping Exercises

SocMon Spatial mapping exercises apply a participatory approach to gathering spatial information. Stakeholder participation can be effective in strengthening capacity and stewardship by promoting and improving local management, through the collection of traditional and local knowledge. Also, a PGIS approach can help to legitimise and promote the use and accessibility of local knowledge. In order to reap the full benefits of PGIS, the project must be underpinned by ethical principles and follow certain guiding procedures and meet certain criteria. These are still flexible enough to be applied to various stakeholder groups and types of projects.


SocMon Spatial uses participatory mapping exercises to collect relevant spatial information. This allows data collectors to gather key information about a place by capturing a visual representation of it. SocMon Spatial enables the researcher to gather this visual representation and combine it with contextual information that aids the understanding of the management considerations that surround or impact the visually represented phenomena. These mapping exercises allow users to think about things in a very different way by emphasising the spatial relationships that exist within a specific area. In other words, the main focus is how things interact within a given space and what these relationships mean for management and planning. SocMon Spatial exercises are used as a tool for helping outsiders to gain an in-depth understanding on the local perspective and reality.

## C2.1: Mapping exercise principles


Mapping exercises will take the form of semi-structured interviews and will follow the standard SocMon protocol (*GCRMN SocMon Manual pages 67-78, 96*). However, for the participatory mapping exercises, a few points must be kept in mind. SocMon Spatial mapping exercises must be:



Participants may lose interest and be unwilling to complete long exercises. Demanding time requirements can build bad relationships.



Time spent collecting specific types of data from key stakeholders can ensure that rich information is gathered from those most knowledgeable about a topic.



Data collectors must not try to sway participant answers based on what he or she thinks is correct.

- Concise

Although large amounts of data can be captured and processed, the mapping exercise can be lengthy. Provisions must be made to limit their duration while maximising the type and quantity of information extracted. Exercises should be kept to less than 15 minutes. When key informants are going about their daily routine, a lengthy mapping exercise can be inconvenient and met with some resistance. For longer exercises it may be necessary to schedule times when these can be facilitated.

- Targeted

SocMon Spatial mapping exercises must be targeted yet flexible. Exercises must adapt to a variety of stakeholders and situations. It is more beneficial to target specific stakeholder groups for specific types of information. Designing and adapting methods to the local situation cultivates buy-in among community members; this can help to save time and improve efficiency during data collection. Designing and adapting exercises to the different stakeholder groups is also good for the participant. It keeps them engaged by focusing on what they are familiar with and have a vested interest in. Also increased engagement can lead to greater sharing and strengthening of relationships.

- Unbiased

Each participant that the researcher or surveyor will interact with is a unique individual that has their own worldview, learning style, interpretation, and personal connection to the phenomena being studied. This is shaped by their culture, upbringing, religion, perceptions etc. This means that each person will be influenced by their own set of biases, including the data collectors. As a result, each individual's perspective (and their worldview) must be given due respect. Therefore, data collectors should gather spatial information as objectively as possible while remaining open to varied input. Participatory mapping is hinged directly on working with people. As a result, the researcher must remain open to and respect the views, perceptions and needs of the participant.

## C2.2: Mapping exercise process

A systematic approach should be used to conduct mapping exercises. Exercises can flow thematically or spatially.

### 1. Thematic mapping exercises

For this approach, the data collector will focus on addressing specific data themes and/or project objectives as the mapping exercise continues. For example, the data collector may focus on gathering spatial data on fisheries activities that occur throughout the study area before identifying information about the threats that may be related to the activities noted.

### 2. Spatial mapping exercises

A spatial progression requires that all variables at a particular location are addressed before progressing on to the next area. For example, mapping exercises can be started at the most northerly point of the study area and progress in a southerly direction, until the furthest extent of the study area is reached. Moving along the study area transect, all of the variables being studied will be discussed with the respondent at each point.



**Figure 9 Spatial data collection indicated in one general direction**

Depending on the survey style of the data collector, one approach may be preferred over the other. However, both approaches can be used to gather the desired information. Depending on the structure of the mapping exercise, the approach can also vary. For example, semi-structured interviews can sometimes take a more informal or conversational approach to suit the situation. In this scenario, the thematic progression tends to work better as conversations tend to be more focussed on themes and not linear spatial progressions.

*Important participatory mapping exercise questions*



**Remember to choose your Key Informants wisely**

In order for precise spatial data to be obtained, key informants must be targeted; they must possess an intimate knowledge of the study area.

- **Who creates the maps?**

Participatory mapping involves the creation of maps by local communities to provide a visual representation of their knowledge of the physical, socio-economic and cultural features at the study site. The data collectors should work with participants to accurately represent the information provided by the key informants.

- **Who develops the GIS?**

By involving stakeholders in the process of development, PGIS supports stewardship and the compliance of stakeholders with marine management decisions. Also, by consulting stakeholders from the community to determine the accuracy and usability of the GIS outputs, empowerment, capacity enhancement and collaborative decision-making are facilitated.

*Steps to conducting a mapping exercise*

**Step 1**

Each mapping exercise should begin with a review of the purpose of the exercise and the variables to be mapped.

**Step 2**

Next, time must be taken to acquaint participants with the map of the study area and the overall mapping process. The relationships between reference points and commonly known areas should be explained to ensure stakeholder understanding of the basemap before proceeding.

**Step 3**

The format for each mapping exercise will be guided by the survey outline or key informant interview guide developed during the preparatory phase. Participants will be asked to answer questions about each variable and the information will be recorded by the data collector. Then participants will indicate the location of the feature being discussed on the map provided. Different mapping (indication) techniques can be utilised, depending on the tool utilised. These include:

### Physical maps

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Respondents can sketch directly onto a laminated map of the study area using coloured markers. The data collector should develop a key for the symbols used in the mapping exercise. Once complete move to Step 4.

### Digital maps

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For this technique, direct digital input of features into a digital mapping software application will be undertaken by the data collector. Participants will identify features on the digital map and guide the digitisation of these features along with the input of any associated attribute data.

#### **Step 4**

Once the data have been recorded on the field maps, the data collector should take a digital photograph of each participant map so that these photographs can later be uploaded to relevant GIS software and digitised.

### *Mapping exercise tips*

The methods utilised for the opportunistic type of field data collection must be tailored to efficiently extract the most data within a short space of time. However, when mapping exercises can be scheduled in a comfortable controlled environment, with an allotted time slot, data collectors can conduct more comprehensive data collection exercises where the surveyor can try to gather as much information as possible about every variable. Such exercises may allow for further questioning regarding variations of the feature characteristics. Also, data collectors may benefit from using a combination of tools. While participants view and highlight features on the physical maps, the data collectors can guide their own digital input of features and attributes. The combination of tools helps with increasing the number of feature and attribute data points collected during mapping exercises of equal time.

Group mapping exercises can help to gather large quantities of diverse data in a short space of time. However, group mapping exercises require more facilitation input by the data collection team. It is important to remember that individuals, communities and stakeholder groups will not always have shared opinions on all topics. As a result, group mapping exercises must seek to extract as many individual responses as well as agreed responses from stakeholders.

Group mapping exercises allow for collaborative evaluation and representation of SocMon Spatial information. Groups should be kept to manageable sizes (approximately five persons per SocMon Spatial facilitator). Group mapping should use large poster maps, large digital map presentations or large spatial construction models that can be used by all members of the group. As respondents provide information, it can be included into the spatial dataset and input of the spatial characteristics and attribute data can be collected as the spatial datasets, models or maps are constructed.

### C2.3: Collecting spatial data for existing and new SocMon sites

#### Existing SocMon sites

SocMon Spatial exercises fall into two distinct categories:

- Those focused on existing SocMon sites, and
- Those focused on completely new study sites.

These guidelines will assist SocMon practitioners in efficiently and effectively applying the SocMon Spatial data collection tools to any SocMon assessment or monitoring programme.

SocMon is a robust yet flexible tool and has already been used at many sites and tailored towards meeting a wide variety of management purposes. As a result, SocMon Spatial must take a flexible, yet standardised, approach to incorporating this methodology into existing SocMon frameworks. i.e. sites at which SocMon has already been conducted or a monitoring programme exists.

In *SocMon Spatial* assessments that are focussed on existing sites, most of the baseline data would have been collected from key informants during the initial SocMon. Therefore, subsequent SocMon Spatial exercises should seek to obtain the necessary spatial data that supports this existing monitoring data. The aim of spatial data collection is to add spatial dimensions to the previously collected data.

Two approaches can be taken:

1. Conduct a full SocMon Spatial monitoring exercise, or
2. Conduct a spatial validation exercise.

#### Option 1:

A full SocMon Spatial exercise can be undertaken when starting a new assessment or monitoring exercise at an existing study site. The entire SocMon Spatial process (outlined in these guidelines) is carried out and the spatial methods utilised can incorporate both the newly collected and the existing SocMon data. This involves the initiation of a full SocMon assessment or monitoring exercise. These exercises will use much of the same variables and have similar project objectives in order to monitor trends and changes related to the previous monitoring or assessment exercise.

#### Option 2:

In the event that a full SocMon cannot be initiated, short spatial validation exercises with the same key informants or those who operate in the same study area can be conducted to determine the extent and spatial characteristics of the previously collected data. For example, if spatial validation of a SocMon assessment is required prior to implementing another assessment, and the previous assessment collected data on types of fishing, then:



- Information on the fishing villages surveyed or the key informants previously targeted should be readily available.
- Follow up with the same key informants or new ones that operate within the same area to gather information on the areas used for different types of fishing would be necessary.
- Previous data on fishing type to the areas utilised for a specific type of fishing should be matched.

### New SocMon sites

The SocMon Spatial data collection process for new SocMon sites - sites at which no previous assessment has been conducted or at which a monitoring programme has not been established - merges seamlessly with the overall SocMon process and only requires the use of a few simple tools and techniques. Surveys, key informant interviews, group interviews, focus groups, observation and a variety of visualisation tools and techniques are employed to gather SocMon data. For SocMon Spatial similar data collection methods are used, with preferred use of key informant interviews.

### C3: Data Collection Instrument Development

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Before primary data collection can begin, it is essential to design a data collection instrument to guide participatory mapping exercises. Key questions must be developed based on the interview guidelines outlined in the [GCRMN SocMon Manual, Chapter 3, pages 96-100](#). Along with these guidelines, SocMon Spatial requires that questions be formulated for each variable to determine the spatial extent of each feature along with its associated attribute information.

**Example:**

When gathering SocMon information, the types of activities that occur within an area may be of importance. SocMon Spatial requires that the location of where these activities occur to be collected.

### C4: Mapping Tool Selection

---

There are various mapping tools that may be utilised for PGIS data collection. The tools vary greatly in cost, ease of collection and ease of data integration. Due to this variability, mapping tools should be chosen based on the characteristics of the study and the local reality. Their strengths and weaknesses must be assessed in order to determine the tools best suited to the assessment or monitoring programme in question. Each of these tools is described below.

**Table 3. Type of mapping tools and associated imagery**

Tool	Imagery
Poster Maps	Satellite Imagery
Handheld Maps	Satellite Imagery
Topographic Maps	Topographic Imagery
Digital Maps	Satellite Imagery
Sketch Maps	None

### C4.1: Satellite poster maps

These maps include high resolution satellite imagery that is zoomed to the area being studied. These maps can be produced at varying poster sizes, but the recommended optimal size for SocMon Spatial mapping exercises is 16 x 24 inches.



**Figure 10: Using poster maps for mapping exercises**

#### Strengths

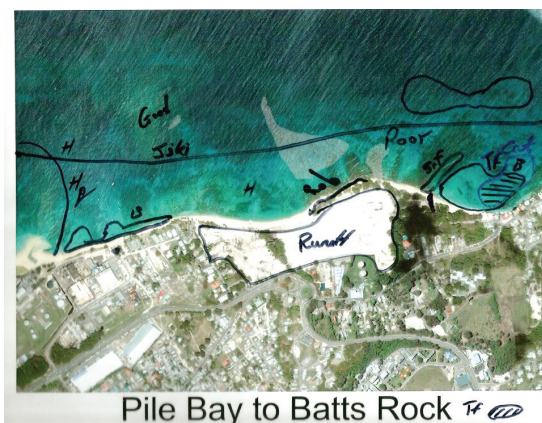
- The large satellite imagery enables participants to easily identify features on the map.
- These maps are colourful and engaging and require no technical expertise for indication which does not deter participants.

#### Weaknesses

- These maps can be costly to produce due to printing and lamination costs.
- In some field data collection scenarios, these large maps can be cumbersome and limit mobility during mapping exercises.

### C4.2: Handheld satellite maps

These smaller maps also include high resolution satellite imagery that is zoomed to the area being studied. A common page size is 8.5 x 11 inches which fits easily onto clipboards to be used in the field.



**Figure 11 Handheld paper maps used for mapping exercises**

**C4.3: Handheld topographic maps**

**Strengths**

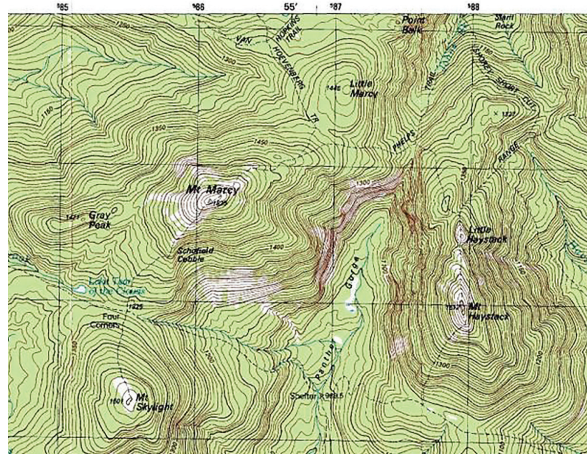
- These maps are colourful and engaging, and require no technical expertise for indication; therefore they do not deter participants.
- Their size makes them easy to manage in the field.

**Weaknesses**

- A suite of maps must be printed in order to zoom into key places on these smaller maps. As a result, it may take three or four maps to show one stretch of coastline with visible infrastructure and landmarks.

These physical maps should all be laminated for protection in the field. Also the inclusion of an indication key sheet can help data collectors interpret the codes, colours and/or indication styles used by the mapping exercise participant.

These smaller maps are created using topographic imagery that is zoomed to the area being studied. A common page size is 8.5 x 11 inches which fits easily onto clipboards to be used in the field.



**Figure 12 Types of topographic maps used for mapping exercises**

**Strengths**

- These maps are less expensive to produce.
- Topographic imagery can be easily obtained from most government departments.

**Weaknesses**

- Topographic maps are difficult to understand for some stakeholders.
- The imagery has proven to be less engaging for respondents.

## C5: Creating Field Maps



Although there are various map types to choose from, satellite imagery often works best for engaging stakeholders and aiding with their orientation and interpretation. High resolution satellite imagery provides the best visual results and can be purchased from the relevant authorities in-country. However lower resolution, open source imagery can also be used such as Google Earth and ESRI imagery.

Subsequent to selecting the mapping tool, SocMon Spatial field maps can now be developed based on the defined study area. Field maps should include the full extent of the study area and then parcel maps should be made for any key focal areas that will require detailed representation. Field maps should include a few easily identified reference points to aid participant orientation during mapping exercises. There are different types of field maps that can be used, including:

- Topographic maps
- Satellite maps
- Land use maps
- Economic/Resource maps
- Road maps



**Figure 13 Handheld paper map with reference points**

# Data Analysis & Database Development

During this phase of the SocMon process the assessment team usually analyses and validates the data to prepare useful reports and communication products for the end-users (Refer to *GCRMN SocMon Manual, Chapter 4, pages 157-171*). Trained GIS practitioners are a significant benefit to the data analysis and database development components of the SocMon Spatial process. This section is designed to guide practitioners that are familiar with GIS processes. However, if experienced GIS practitioners are not readily available, it is still possible to complete a SocMon Spatial study, but this will require some supplemental training in GIS techniques. This component of the SocMon Spatial process is focussed on unlocking the major strengths of merging PGIS with SocMon

Large quantities of SocMon data can be manipulated and repackaged into datasets for communicating and informing decisions.

GIS is a very powerful tool that can be used to disaggregate large datasets in order to extract information that is specific to the SocMon study. For example, large demographic datasets can be imported into a GIS and assigned to specific locations and each location can be analysed using primary data collected during the SocMon study.

A GIS practitioner can be contracted to ensure that SocMon Spatial team members are trained to meet the geospatial analysis requirements of the SocMon Spatial study. This manual does not provide introductory GIS skills training however it will provide users with the guiding principles necessary for developing SocMon Spatial projects, databases and outputs.

#### Online training sources include:

- ESRI ArcGIS Online Training: <https://www.esri.com/training/arcgis-online-training/>
- Lynda's GIS Courses: <https://www.lynda.com/search?q=gis>
- MIT GIS OpenCourse: Lectures
- Penn State, Maps and the Geospatial Revolution: <https://www.coursera.org/learn/geospatial>
- Penn State, Maps and the Geospatial Revolution GEOG 885: <https://open.ems.psu.edu/node/1355>



## D1: Spatial Data Analysis

### D1.1: Analysis tools

#### **Missing or expired GIS software is not a limiting factor**

In the event of limited access to GIS software package subscriptions there are various free and open source software packages that can meet the organisation's SocMon Spatial GIS requirements.

Open source GIS software package options include QGIS, Geo Server and SAGA GIS. QGIS is the recommended open source software package for SocMon Spatial because of the constant development of additional third party applications that improve ease of use for various geospatial processing tools. This program has been utilised for SocMon Spatial product development.

### D1.2: Preliminary data processing

There are no specific geospatial analysis requirements that may restrict the SocMon Spatial project team. This component should be tailored to suit the objectives of the SocMon Spatial study in question. The only stipulation for this component is that all analysis procedures should be clearly outlined in the SocMon Spatial metadata. Although there are no restrictions, this section will provide certain guiding principles to aid the data analysis process for meeting specific project goals.

There are many GIS packages which have their own suite of geospatial analysis toolkits that vary in complexity, adaptability and accessibility. Consequently, the resources and GIS capacity of an organisation can play a big role in software choice and geospatial analysis tool selection. Nevertheless, these analysis tools are all based on standard geospatial analysis principles that may be applied for reaching specific outcomes. This information must therefore be communicated within the SocMon Spatial metadata. If a specific geospatial analysis tool has been chosen, the tool used and its purpose must be clearly communicated for future reference. This will allow the SocMon team to follow similar procedures if they so desire for future SocMon Spatial projects.

GIS software packages usually have a suite of specialised geospatial tools that can be used to transform the collected spatial data. Before the data are compiled and transformed via geospatial analysis, a certain degree of preliminary processing may be necessary to make the data usable. Some simple principles for preliminary data processing are discussed below.

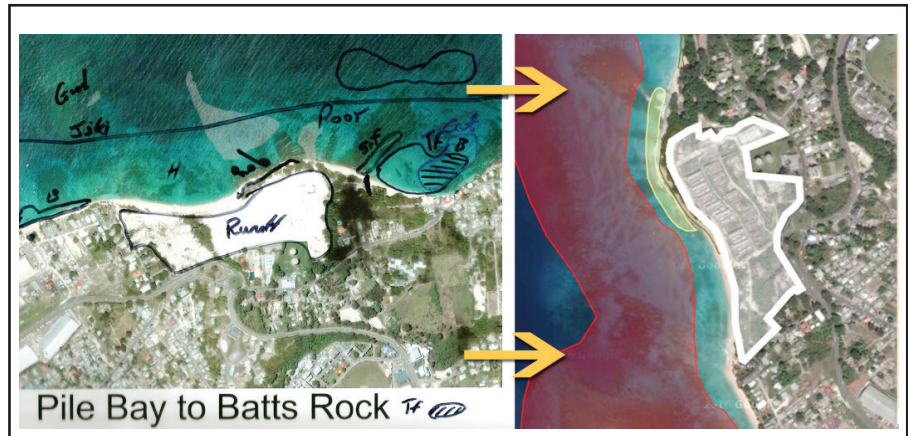
Since SocMon Spatial gathers a large quantity of both feature and attribute data from respondents, these data must be formatted before they can be analysed and represented.



## Spatial data processing

### Digitising

All spatial data will need to be digitised. If using digital input in the field, this step would be completed during the data collection phase, but if physical indication on field maps is used, then digitisation is the first step in the data processing component.



**Figure 14: Digitisation of field maps**

Different GIS software packages have different digitisation tool categories however they all follow the same process.

#### Step 1

Import field map images into the mapping software.

#### Step 2

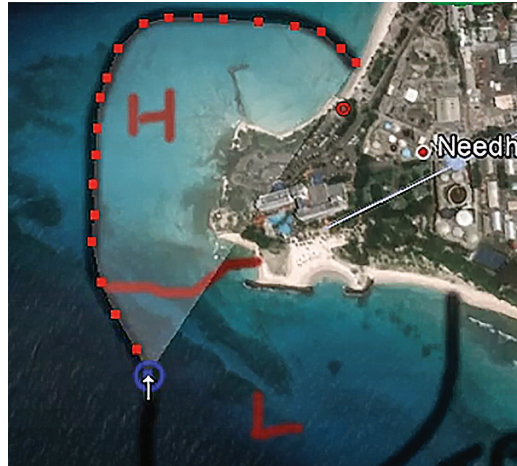
The field map must then be geo-referenced or geo-rectified. The maps that were used in the field must be linked to their corresponding locations 'on-the-ground'. The geo-referencing process relies on the alignment of points on the mapping exercise image with detailed data features or imagery that is already spatially referenced. In the mapping software, captured pictures can be aligned with the spatially referenced satellite or topographic imagery within the GIS.

Good geo-referencing requires the alignment of chosen reference points and use of good control points.

- It should be easy to identify control points. Using clearly defined points that are unlikely to change is critical (e.g roadway intersections, stable points on key natural or infrastructural landmark, etc.).
- Reference points should be spread evenly across the image. Focussing heavily on one area can skew alignment in others. It may be useful to use points near each of the corner of the image along with a central control point.

### Step 3

Create GIS features that represent the features drawn onto field maps by mapping exercise participants. These images must be digitally traced to create vector features that can be interpreted and analysed using a GIS software package.



**Figure 15** Field map digital tracing

Once the mapping exercise data have been digitised they may now be incorporated into the GIS to be processed and analysed.

### Processing the Raw data

After digitisation is complete, there will be many unique spatial data points that must be interpreted. SocMon Spatial projects will gather information from multiple respondents but this information will be combined to produce spatial outputs that represent the collective responses. Various tools and techniques exist to compile data points and process raw data, however SocMon Spatial utilises simple processing techniques to refine the spatial data before any extensive analysis is conducted. These three data processing techniques will aid interpretation and future analysis:

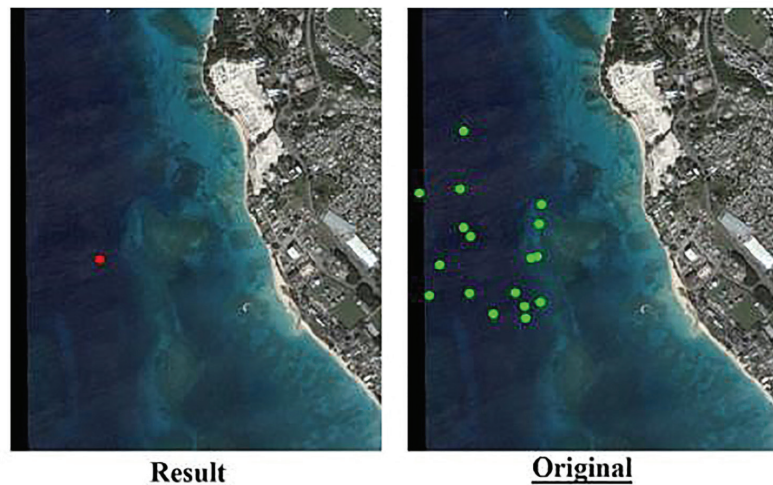
- Median selection
- Intersecting
- Merging

These tools are not specific to any GIS software package and various tool names may be found for performing the same action. However, the actions and intended results are explained below.

### Median selection

Median selection is primarily used for point features.

This process determines a central point location from many points collected during SocMon Spatial mapping exercises. When many participants are asked to show the location of a specific feature they are likely to have varied responses within one general location; however, a common point based on the data provided by the respondents must be found. Utilising all the points indicated by respondents may allow for the final product to be heavily skewed by any outliers. As a result, some of these outliers must be removed

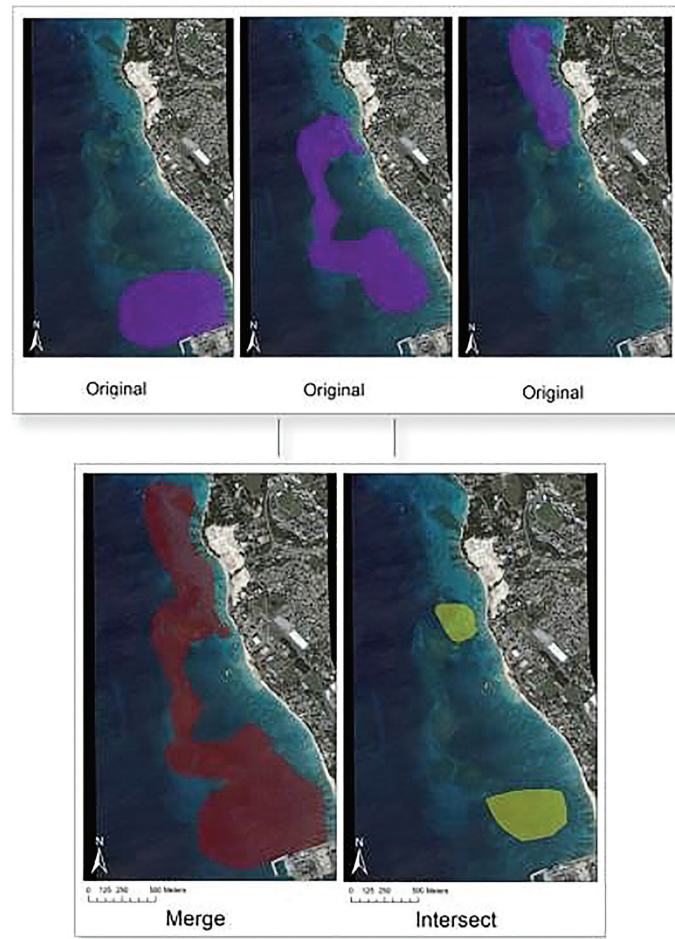


**Figure 16 Median analysis output example**

In ArcGIS, the 'Median Centre' analysis tool can select a radius for analysis, in order to exclude outliers. Therefore, only points within a predetermined radius would be considered for determining the final point location. This is used as the primary preliminary analysis tool for point features in SocMon Spatial projects.

### Intersecting

Intersection is used to select only areas that respondents hold in common. This action captures the extent agreed upon by various respondents thereby eliminating duplication and severe outlying variations in key informant perceptions.



**Figure 17** Intersection and merge analysis output examples

In ArcGIS, the 'Intersect' tool can be used to select overlapping areas of the mapped features. This tool removes outliers and utilises only extents that fall within a defined space. This tool may be well suited to scenarios where there is a wealth of mapped features from a large number of sources. It may also be well suited for projects focussed on analysing "hot-spots" or areas being impacted the most. In these scenarios, intersection will help to pinpoint these key areas, based on the collection of respondents' opinions.

### **Merging and overlay analysis**

Conversely, when there is limited information, it may be necessary to incorporate all possible responses. The merging of duplicated features allows for the inclusion of all variable-specific information provided by a key informant. This ensures that no key informant's views or perceptions are excluded from the final product. It can help to accurately represent the full spectrum of collected data to enable the capitalisation of the available spatial knowledge even in scenarios with data limitations. As a result, the 'Merge'



The preliminary processing tools best suited for SocMon Spatial studies are dependent on the characteristics of the data collected. It is recommended that analysis decisions should be made on a project by project basis and the process and reasons for selection must be clearly outlined in the metadata. Once properly outlined, the analysis methods can be easily interpreted and replicated in future monitoring efforts.

tool is often used for features in SocMon Spatial projects with limited data and low numbers of knowledgeable key informants.

For example, if spearfishing activities are being studied but all of the stakeholders that were interviewed fished at different locations it may be incorrect to use intersecting areas as the spearfishing locations. However, by merging all of the collected information, all spearfishing areas can be shown based on the existing knowledge. Therefore, the 'Merge' tool is often the preferred option in data-scarce situations as it provides a better representation of the bigger picture.

However, merging is not only for data-scarce scenarios, another valuable analysis tool often used for SocMon Spatial projects is the 'Overlay Analysis' tool. This tool can be used with large amounts of data, to select areas where a chosen percentage of the collected data overlap or for categorisation based on the number of overlapping polygons. The 'Overlay Analysis' tool can be used to view and select only areas that are agreed upon by a predetermined proportion of key informants.



A spatial database or geodatabase is a database that has been developed to house, process and access data that represents specific objects within a geometric space.

## D2: Geodatabase Development

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One of the benefits of SocMon Spatial is its ability to store and manage large amounts of spatially referenced SocMon data. A GIS can be used to effectively manage this wealth of data and generate outputs for interpretation of this data.

The geodatabase standards used for SocMon Spatial are designed to inform database management for socio-economic monitoring programs. The value of creating a database of spatially referenced SocMon information is that it provides:

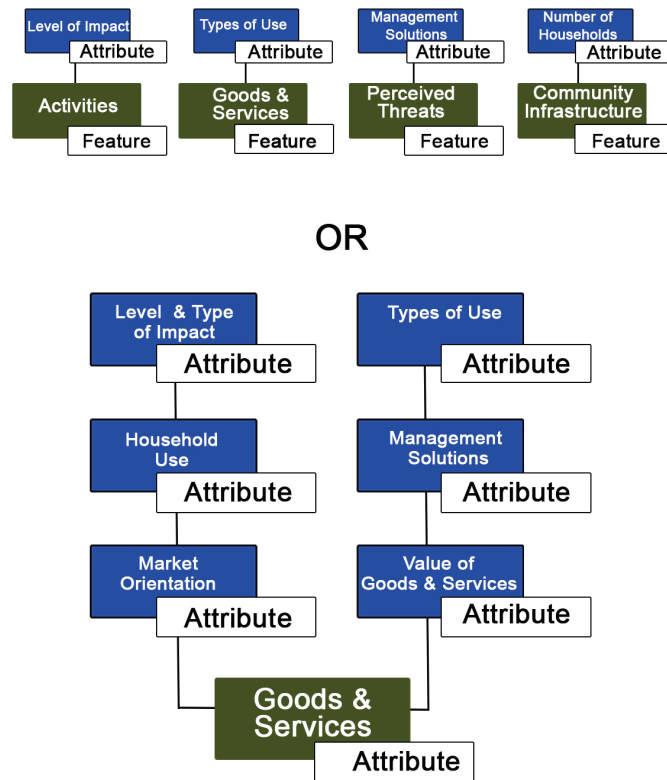
- A digital repository of information that can be queried to meet data needs.
- A framework that can be used to collate data of different types from varying sources.
- A structure that can streamline the combination and sharing of data.
- A secure and central location for SocMon data storage.



**D2.1: Geodatabase structure guidelines**

Geodatabase structure is heavily determined by the outcome of the variable packaging exercises (Section A2). These exercises define what will be visually depicted as features on the map as well as the attributes that are linked to each feature as descriptive elements. These linkages are used to inform how shapefiles and map elements are made.

For example, with ArcGIS and QGIS, a shapefile will be created for each feature variable and the attribute variables defined in the associated variable package will be included in the attribute table.



**Figure 18 Geodatabase link examples**

**D2.2: Metadata standards**

Metadata outline the process and parameters used in developing a dataset. They play an important role in ensuring and determining data quality. Metadata facilitate the use of the data or databases that they describe and as a result, proper metadata development is essential. In order to improve database integration and exchange, clear metadata standards are required. Monitoring requires the use of consistent methods in order to allow valid comparisons of results over time. As a result, metadata must be clearly and concisely outlined to ensure that methods can be replicated.



The *SocMon Spatial* metadata parameters follow a simple rule. Metadata must answer the questions of what, when, how, why and who:

- What type of dataset is it and what types of data are included in the dataset?
- When was the dataset created and if it is based on previous data, what time period is that data from?
- How was the dataset created? What tools and methods were used?
- Why were these tools and methods used?
- Who created the dataset?
- What attributes are included?
- What spatial datasets were used?

By including the answers to these questions in the project's metadata files, metadata quality standards will be met for use of the developed datasets in future SocMon projects as well as for other coastal and marine management efforts. The GIS software's metadata editor will contain fields that meet each of these criteria and the metadata will be saved directly within the SocMon Spatial GIS file.

# SocMon Spatial Outputs

**T**he true value of any monitoring initiative comes in the ability to produce results that can inform decision-making and guide better management. The results that are produced must be effectively communicated to have the intended effects outlined in the SocMon assessment or monitoring programme objectives.

The SocMon methodology outlines various tools that can be utilised to effectively communicate the monitoring event's results to stakeholders, community members and decision-makers (*GCRMN SocMon Manual pages 113-144*). However, SocMon Spatial and these guidelines are specifically focussed on the visualisation of SocMon outputs.

## E1: Validation Exercises



In order to obtain large and diverse attendance, different stakeholder groups may need to be contacted separately in forums best suited to them.

Stakeholders that are knowledgeable about the features presented in the project outputs are necessary for the validation component. Without these stakeholders, relevant and detailed feedback cannot be obtained.

Validation is an essential component of the SocMon and PGIS processes. This is where SocMon Spatial products can be assessed by the stakeholders to:

- Confirm accuracy.
- Ascertain approval of outputs by the different stakeholder groups.
- Determine gaps that must be addressed.
- Explore if and how the final outputs can be used to meet stakeholder needs.
- Determine stakeholder consensus on specific issues.
- Express gratitude to stakeholders responsible for providing the data.

For SocMon and PGIS projects, multi-stakeholder meetings are a commonly used forum for validation and feedback. At these validation meetings stakeholders should be presented with the developed SocMon Spatial map products either through physical maps or an interactive digital map. Stakeholders should be given the opportunity to discuss the strengths and shortcomings of the map products. The shortcomings should be recorded and addressed to ensure that the SocMon Spatial outputs can effectively meet the needs of the project's stakeholders. Oftentimes the shortcomings may even be addressed using the knowledge provided by the stakeholders present at the validation meetings.

Stakeholder validation can also be done remotely by creating web maps that can be viewed by key stakeholders and then relevant feedback can be obtained online for improving the outputs for use by different stakeholder groups.

## **E2: Data Representation and Sharing**

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This is where the SocMon Spatial data is manipulated to communicate relevant messages to target audiences. Whether trying to inform policy and decision-making or influence public opinion and promote awareness, SocMon data can be visualised to meet relevant goals.

### **E2.1: Representation**

SocMon Spatial's visualised outputs can be provided in various formats. The digitised and spatially referenced data (Section D1) can now be exported in different formats. For example, SocMon Spatial data can be represented using:

- Physical maps.
- Digital map interfaces using Web 2.0 technologies.
- Spatially analysed and referenced figures.
- Multimedia packages.

### **E2.2: Sharing**

The outputs of a PGIS project should be made available to the stakeholders involved, in order to enhance benefits to the host community and/or organisations. Often the outputs of conventional GIS are only made available to decision-makers, while communities and stakeholder groups have little input regarding its contents or use. However, in enhancing stewardship and fostering adaptive management, collaborative techniques must be encouraged. The exchange of information is therefore an integral component of adaptive management.

Web-based tools can be used to exchange information quickly and freely. As a result, SocMon Spatial projects should seek to include open-access web tools for communicating some of the spatial outputs to the project's stakeholders. The spatial outputs can be converted to a format which can be accessed publicly in Google Maps, Open Street Maps or the ESRI online mapping interface. This conversion can be done by using KML conversion tools for shapefiles within the mapping software.

### E3: Creating SocMon Spatial Maps

#### E3.1: Using physical maps for displaying results

SocMon Spatial can be used to generate physical or digital maps that help to communicate monitoring results and key lessons learned from the SocMon study. Providing visual products through SocMon Spatial outputs can help to:

- Engage user groups.
- Overcome literacy barriers.
- Provide alternate communication and outreach options.

The results of a SocMon study can be presented and supported using printed maps. It is essential that SocMon outputs should be made freely accessible and easy to understand or use. The physical maps that can be produced through SocMon Spatial present a simple, but engaging data display option.



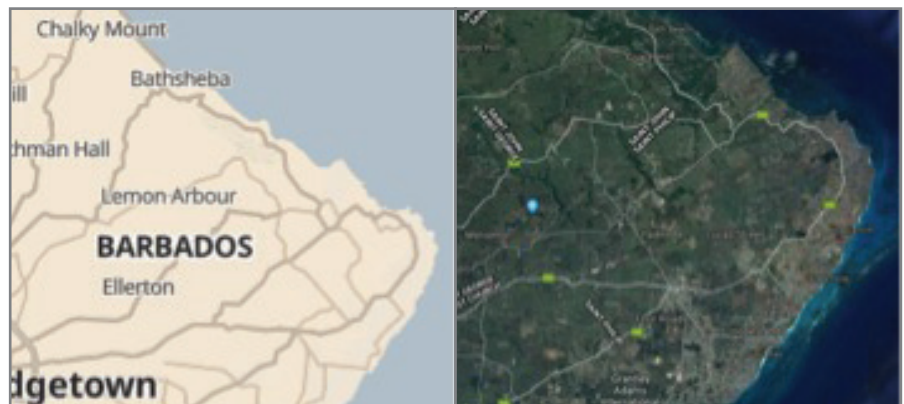
**Figure 19 SocMon spatial Physical map examples**

Cartographic maps, topographic maps and geophysical maps are all widely used to represent valuable information that is used to describe a specific spatial extent. The data collected through SocMon is given the necessary 'spatial parameters' (x,y coordinates, addresses and vector model indicators) that are necessary for describing the socio-economic monitoring details present within a specified area.

**E3.2: Using digital maps for communication and informing decision-making**

**Maps should be visually appealing**

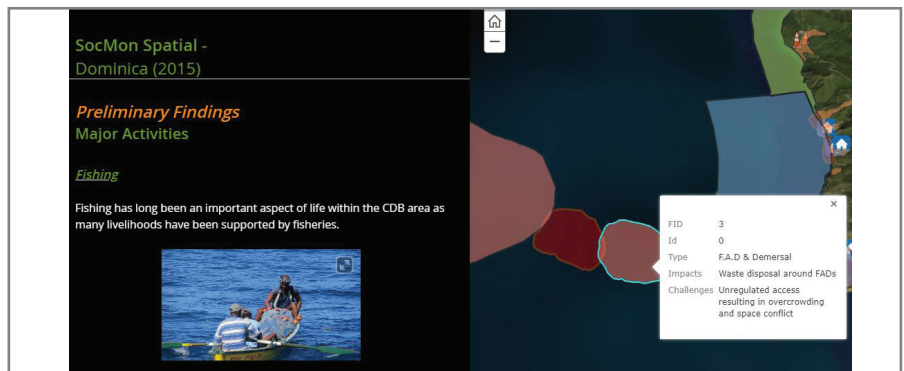
Technocrats often utilise scientific or academic outputs to communicate the results of monitoring exercises. However, the use of different channels and formats may be beneficial for effectively communicating technical information to diverse audiences. The same information can be visualised in many different ways. Each format will have its own strengths and weaknesses. Simple things like colour association can have a significant impact on the ability of persons to easily understand the information being presented. Appealing colour combinations and imagery as well as user-friendly interfaces should be used to improve uptake and understanding of the spatial outputs.



**Figure 20** Different map types: topographical map (L) versus a satellite map (R)

**E4: Web-based Mapping Tools**

SocMon Spatial outputs can be incorporated into various web-based mapping interfaces to meet different objectives.



**Figure 21** ESRI story map example

Web-based tools (story map in the image above) can be used to:

- Store SocMon Spatial data on a secure cloud platform.
- Share SocMon Spatial data with specific collaborators.
- Share SocMon Spatial data with the general public.

Each of these objectives can be met using the same web tools by simply changing the sharing and accessibility preferences available within the web-mapping interface. However, different web-based mapping tools may be used based on the specific communication objectives.

### E4.1: Using web-based tools for education & public communication

Web-based tools can be used to enhance education and training. These tools can incorporate multimedia packets such as figures, documents, images and video that are most effective for public communication. The incorporation of multimedia resources can be effective for engaging viewers with different interests and learning styles. Web-based tools are easily made publicly available to ensure that maximum exposure is attained.

#### Include engaging media

Similarly, the use of multimedia is also beneficial for increasing engagement and maximising communication potential. The introduction of web 2.0 tools and the advancement of social media and mobile applications has transformed communication and information exchange in the 21st century. Large amounts of information can be shared at the touch of a button through different types of media and this has influenced the global culture of communication.

By incorporating multimedia into SocMon spatial web-map outputs, researchers and managers are better able to engage persons who have become familiar with the concept of using web-based multimedia platforms for communication.

#### Enable open communication on web-map products

The interactive nature of these web-based mapping tools is a major asset for communication and stakeholder engagement. Web tools can be incorporated into social media, e-mail threads and other online communication tools for increased exposure and obtaining feedback. The two-way communication channels that exist in the online space allow SocMon Spatial outputs to capture audiences and feedback long after the project is completed. This feedback can be used to inform future monitoring efforts while the live web-based communication channels can be used to simultaneously communicate the project results, outcomes and impact over time.



**Open communication may be maximised by:**

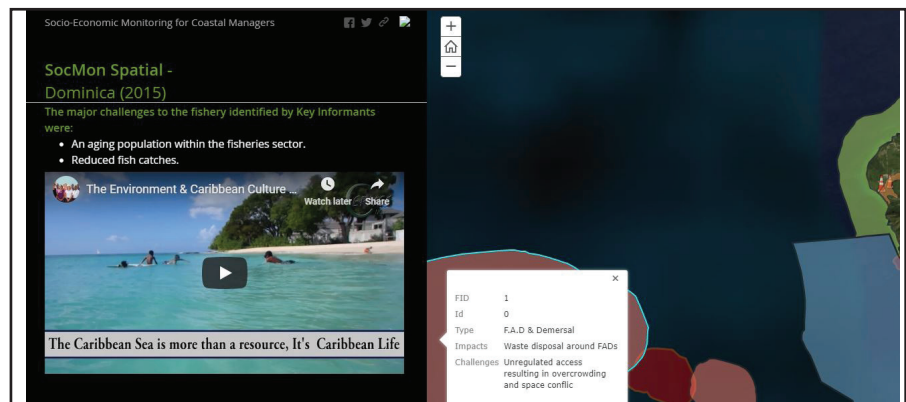
- Enabling any native commenting features
- Sharing web-map outputs via social media



Communication culture has been significantly impacted by the advent and development of social media. The ability to share information to global audiences at the click of a button has influenced various components of our modern lifestyles. This highly effective communication tool has been harnessed by various sectors including entertainment, business and politics. As such, its use can also prove to be advantageous for education, awareness and effective communication.

#### E4.2: Using web-based tools for collaboration and database development

Web-based tools can be used to collaborate and develop datasets remotely. SocMon Spatial collaborators from different departments or even countries can use cloud storage and free online web-mapping portals (like ESRI's ArcGIS online) to share information and work collaboratively on SocMon Spatial datasets.



**Figure 22** Video embedded in ESRI StoryMap

Web tools that can incorporate multimedia packets such as figures, documents, images and videos are very effective for public communication. The incorporation of these multimedia resources can be effective for engaging viewers with different interests and learning styles. Due to modern accessibility to free cloud-based media platforms such as Youtube, Vimeo, Flickr etc., the incorporation of rich media is not restrictive.

## **E5: Creating a SocMon Spatial Web-based Map**

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There are various types of web-based tools that can be used for SocMon Spatial, including:

- **Interactive Application Programming Interface (API) repositories**

These interactive repositories store spatial information in an interactive database that can be used to show and hide SocMon Spatial features, based on the user preferences. For SocMon Spatial, Google's API was used to develop a simple map with toggle functionality. This type of mapping tool can be restrictive as it requires developers to have a good working knowledge of programming language.

- **Google maps platforms**

The Google Maps interface is arguably the most widely used mapping portal that is used by the general public. Consequently, access to the platform is simple and the user-friendliness and interface support make the use of this platform very attractive to new spatial-planning practitioners.

- **ESRI ArcGIS online**

ESRI has an open-access online platform where maps can be created, shared and edited within an online space. A wide range of apps and communication platforms are also available through this online portal including:

- Story maps
- Map journals
- Digital maps
- Data summaries

Through the apps provided on ESRI's Online Portal, a wide range of GIS functions can be carried out through this free online tool. Collaborative creation, simple sharing and cloud-based storage are aspects of the ESRI ArcGIS online platform that can be used by SocMon teams that are working on resources remotely.

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# Resource Links

In this section you can find additional resources that can help users gain a deeper understanding of GIS, participatory mapping and spatial analysis practices.

## Open-access GIS training

- ESRI ArcGIS Online Training: <https://www.esri.com/training/arcgis-online-training/>
- Lynda's GIS Courses: <https://www.lynda.com/search?q=gis>
- MIT GIS OpenCourse: [Lectures](#)
- Penn State, GEOG 885: <https://open.ems.psu.edu/node/1355>

## PGIS Resources

Participatory Spatial Information Management & Communication Training Kit:

<http://pgis-1k-ea.eta.iatl>

Participatory Avenues:

<http://www.iapad.org/>

Open Forum on Participatory Geographic Information Systems and Technologies:

<http://www.ppgis.net/>