Visitor Use observation and monitoring in Mediterranean marine protected areas.

Solenn Le Berre, Ingrid Peuziat, N. Le Corre, Louis Brigand

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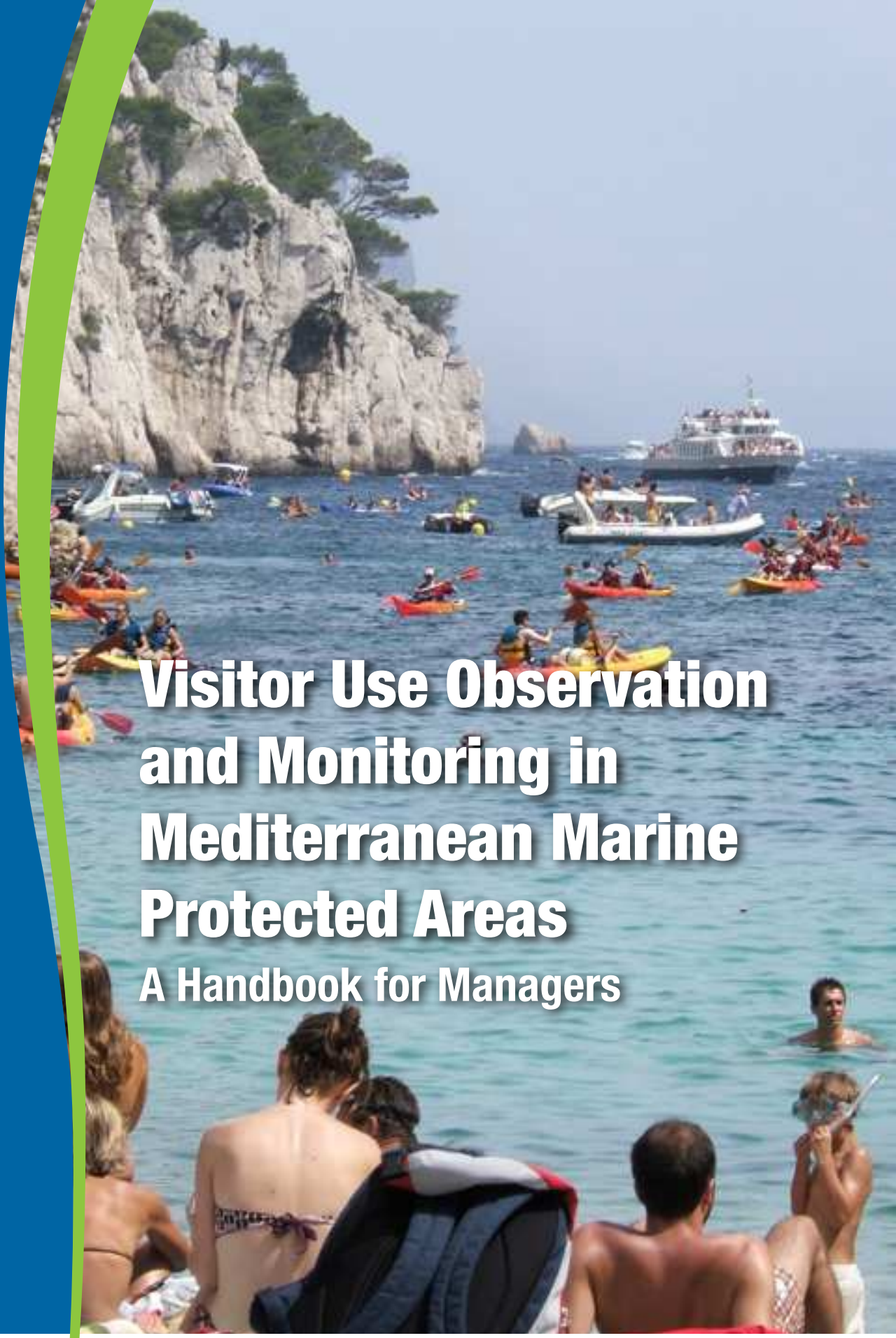

Visitor Use Observation and Monitoring in Mediterranean Marine Protected Areas

A Handbook for Managers

WWF MEDPAN NORTH PROJECT

Med

Parc national de Port-Cros

LETG brest géomer

UBO université de bretagne occidentale

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Responsible Publishers

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The organisation has an operational network spanning 100 countries and supporting 1,200 nature protection programmes. WWF's mission is to halt and then reverse the destruction of the planet.

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MedPAN North

The MedPAN North project is a transnational European project with the general aim of improving management effectiveness of marine protected areas in the Northern Mediterranean. It is conducted under the stewardship of the MedPAN network and is coordinated by WWF-France. It involves 12 partners from 6 European countries bordering the Mediterranean: Spain, France, Greece, Italy, Malta and Slovenia. The project is co-funded by the European Regional Development Fund through the Med Programme, with a budget of €2.38 million. The project began in July 2010 and will run through to June 2013.

> www.medpannorth.org

Parc national de Port-Cros

The Parc national de Port-Cros (Port-Cros National Park) was founded on 14 December 1963. The Park covers 700 hectares of land and a marine surface area of 1,288 hectares. It is one of the oldest National Parks in France and the largest marine park in Europe. Within the framework of its tourism management objectives, the Park has established the Bountîles observatory to monitor visitor use of land and sea on and around Port-Cros island.

> www.portcrosparcnational.fr

Authors

LETG Brest Géomer - UBO

The Géomer team is the Brest-based section of UMR 6554 LETG (Littoral, Environnement, Télédétection, Géomatique) which consists of five geography teams in the West of France (Brest, Nantes, Rennes, Caen and Angers). LETG Brest-Géomer is a member of the Institut Universitaire Européen de la Mer (IUEM), a unit of Université de Bretagne Occidentale (UBO). The laboratory carries out research in the extensive field of geography, focusing particularly on analysing and understanding the dynamics of complex systems, at the interface between Nature and Society.

Islands and marine areas form the main field of investigation of many of the laboratory's researchers. Working in cooperation with numerous partners (National Parks, Conservatoire du Littoral, Nature Reserves, Agence des aires marines protégées, etc.), LETG Brest-Géomer develops research in scientific observation of land and marine use, integrated tourism and recreation management on island, archipelago and coastal sites and the operational implementation of visitor use observatories, particularly in the Mediterranean Sea and the Channel.

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> http://letg.univ-nantes.fr/fr/laboratoire/5/presentation

Financial Partners

MED Programme

The MED Programme is a transnational European cooperation programme conducted within the framework of the European Union cohesion policy "territorial cooperation" objective. Partners from thirteen countries including all those on the Northern Mediterranean coast work together to strengthen competitiveness, employment and sustainable development in this area.

> www.programmemed.eu

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Foreword

Tourism in the Mediterranean

Tourism is a vital economic activity for all countries around the Mediterranean Sea. Given their location at the crossroads between three continents, these countries attract 30% of global international tourist arrivals. In 2007, they received some 275 million international tourists. Tourism is therefore a source of employment and foreign currencies, and greatly contributes to economic development in Mediterranean countries.

Tourist activities generate two kinds of environmental impact: impacts caused by visitor movement and those caused by visitor accommodation. As tourism in the Mediterranean is very much based on the sea, all facilities specifically constructed along the coast contribute to the impairment of natural shorelines. Development of recreational boating further contributes to the phenomenon with the construction of space-consuming harbours and marinas.

These impacts are heightened by their concentration in time (summer season and school holidays) and in space (along the coast, in the mountains, in certain towns and on major sites). The high population density generates pressure on water resources and natural environments and an increase in waste production (Source: Plan Bleu).

Marine protected areas and tourism

The natural environment of marine protected areas is a key resource for tourist leisure activity in the Mediterranean. Tourism is therefore by far the main activity that interferes with marine protected areas.

Mass tourism places considerable pressure on the environments protected by marine areas located in the vicinity of tourist flows. Tourist activities must therefore be managed sensibly, and in a manner compatible with the protection of natural resources.

While managers of marine areas have no way of influencing local tourism overall (development of rental accommodation around a protected area, development of a regional tourism diversification policy for example), they can however take action in the sectors of leisure activities carried out on their sites (boating, diving, surfing, recreational fishing, etc.).

Need for tourist use information

To develop ecologically responsible tourism, tourist activity management should be planned as part of the management plan generally implemented within the framework of marine protected areas.

In this respect, knowledge and scientific monitoring of tourist use and the impacts of tourism are a necessity for managers keen to preserve the good environmental status of a marine protected area. Even if the means are limited, MPAs must be able to monitor variations in tourist practices, with the same conviction and similar resources to those employed to monitor natural heritage. Regular observation of tourist and other uses is today a key factor in good area management.

In-depth knowledge of tourist activities will enable managers to take appropriate management measures such as the establishment of visitor quotas, site developments (organised moorage for example), pricing policies, waste management, etc.

Produced within the framework of the MedPAN Nord European project coordinated by WWF-France under the stewardship of the MedPAN network of Mediterranean marine protected area managers, this guide aims to held managers understand tourist uses and introduce appropriate monitoring systems in their MPA.

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1. Purpose and target audience of the guide

This guide is the result of work carried out in cooperation by Mediterranean MPA managers and a team of scientists which has tested methods for studying visitor use with Port-Cros National Park in France.

1.1 Why study visitor use?

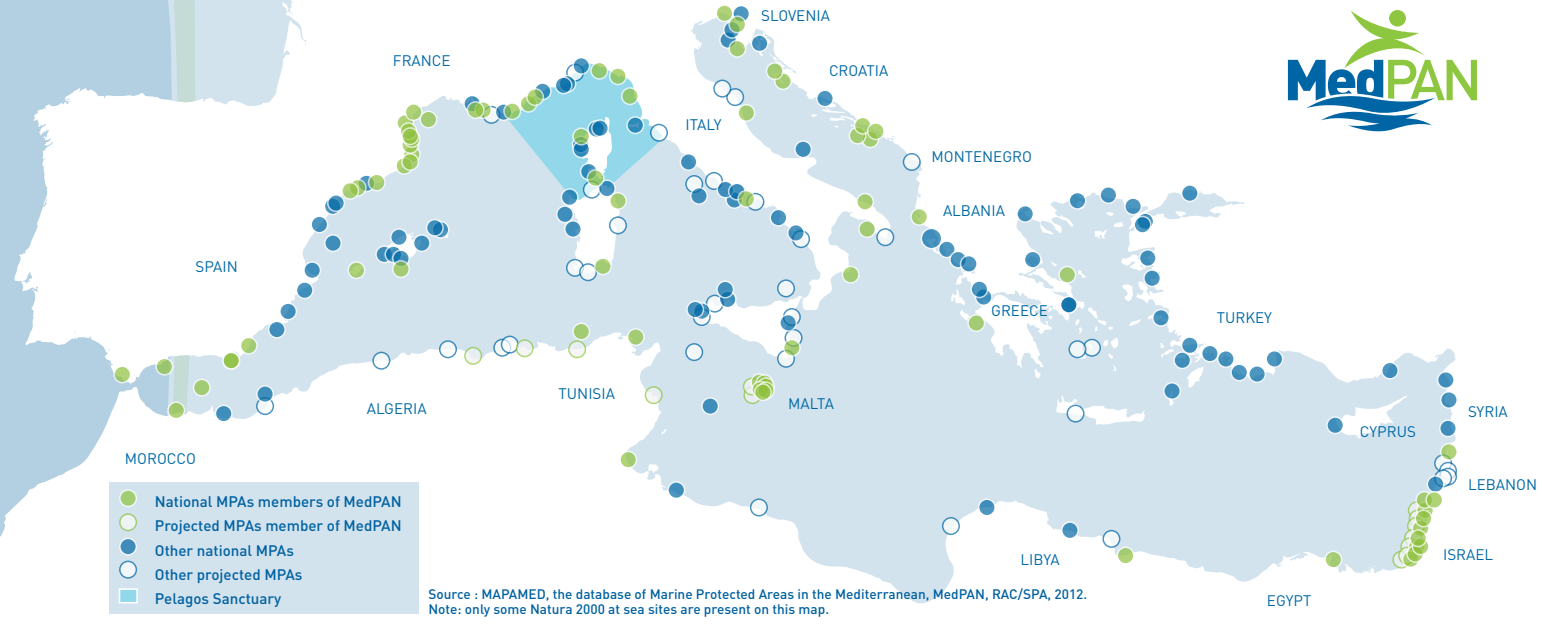
In all natural protected areas, irrespective of the type, it is the managers' role to reconcile environmental protection with their sites' opening to the public. Visitor impacts on protected habitats and species must be restricted, while fostering the positive effects of tourism on a social, cultural and/or economic level. To implement sustainable, balanced management, managers need to define the ecological conservation status of their site, and quantify and qualify the human activities to which it plays host.

Passengers arriving by boat on Port-Cros Island, Port-Cros National Park (France). © Credit : LETG Brest-Géomer UMR6554

Knowledge of the natural environment has traditionally been the priority focus in protected areas. Managers have long used environmental conservation monitoring tools. Tools for monitoring visitor uses and the related socio-economic aspects, however, are less extensively developed and respond to more recent concerns. As an example, of the 1,200 studies carried out since 1963 at Port-Cros National Park (France), only five relate to human and social sciences.

Today, managers are in search of standardised visitor use monitoring tools that will provide the data required to render visitor use compatible with site conservation, improve visitor and local community wellbeing, boost the positive effects of tourism, improve internal management and plan for future changes.

Figure 1 : Marine Protected Areas in the Mediterranean - The MedPAN network in October 2012



Source : MAPAMED, the database of Marine Protected Areas in the Mediterranean, MedPAN, RAC/SPA, 2012.
Note: only some Natura 2000 at sea sites are present on this map.

1.2 Scientific cooperation and guide development process

1.2.1 Request by the MedPAN Nord project

Managers today have recurring needs and high expectations for addressing the issue of human use of their MPAs. There are four major causes at the root of the management difficulties encountered :

- the Mediterranean is a world-leading region for tourism;
- the region's MPAs face major pressure from tourist use and the stakes are high;
- local entities tend to have limited financial resources;
- manager expertise in visitor use monitoring is relatively underdeveloped on the whole.

1.2.2 The experience of LETG Géomer and Port-Cros National Park (France)

The geographic research laboratory LETG Brest Géomer (UMR 6554 CNRS) initiated scientific work on the observation and monitoring of visitor use in coastal, marine and island areas in 1995. In the Mediterranean area, LETG Brest Géomer began developing original visitor use monitoring methods in 2001 in cooperation with Port-Cros National Park (France). The National Park has had a visitor monitoring observatory, named Bountîles, since 2003. The observatory is a pioneering achievement in French MPAs, allowing quantitative and qualitative variations in the main recreational activities (diving, walking, boating) to be monitored.

1.2.3 From the seminar to the guide

For several years now, action taken with Port-Cros National Park has aroused interest beyond local boundaries. In 2007, Géomer conducted a study (within the framework of the INTERREG IIIC MedPAN programme), to do the groundwork for an initial transfer of knowledge developed in Port-Cros to the other MedPAN network MPAs.

The knowledge transfer process continued more concretely from 6 to 8 June 2011, at a seminar organised by the MedPAN Nord project, attended by 11 MPA management entities, the LETG Géomer scientists and WWF-France, the project coordinator.

During the seminar, managers reported a great variety of experiments and raised many questions concerning methods and techniques. The presentations they gave highlighted the varying degrees of experience in the study and management of human activities. A shared need for visitor use monitoring tools thus emerged: tools that are easy to use, scientifically validated, and adaptable to the diversity of MPAs in the Mediterranean.

Participating MPAs
Les Calanques de Marseille National Park (France)
Cap de Creus Natural Park (Spain)
Port-Cros National Park (France)
Taza National Park (Algeria)
El Estrecho Natural Park (Spain)
Montgri, Medes Islands and Baix Ter Natural Park (Spain)
Côte Vermeille Marine Nature Park (France)
Strunjan Nature Reserve (Slovenia)
Debeli rtiç Natural Monument (Slovenia)
Marine Protected Areas managed by Epasa (Turkey)
Cap d'Agde Natura 2000 marine site (France)
Other entities
LETG Géomer Brest (UMR 6554 CNRS), geographic research laboratory
Parcs nationaux de France
WWF-France

Table 1 : List of organisations participating in the seminar on "Visitor use monitoring in Mediterranean MPAs", 6 to 8 June 2011, Cap d'Agde (France).

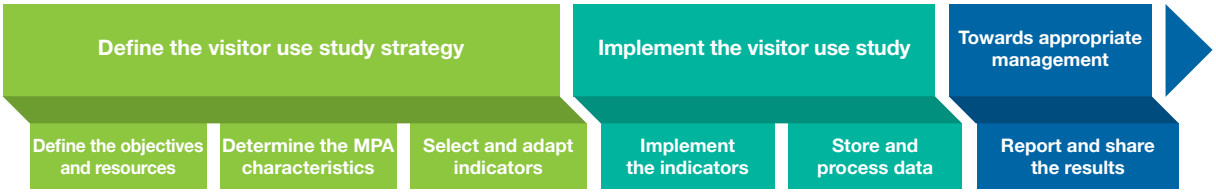


Figure 2 : Steps in the method proposed by the guide for the visitor use study.

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1.2.4 Aims of the guide

This guide aims to provide managers of MPAs in the Mediterranean with step-by-step guidance to carry out a visitor use monitoring project that :

- is suited to the specific features of their site;
- responds to their management issues;
- is scientifically coherent;
- is in line with available resources.

This guide comprises three main parts based on the three steps of the monitoring project method :

- an analysis explaining the approach to help managers develop a monitoring project prior to implementation (sections 3, 4 and 5);
- a series of indicators presented as operational datasheets (section 6), to be adapted by managers to their project. The indicators can be used separately, and on a one-off or ongoing basis;
- a visitor use data processing and reporting protocol together with useful recommendations for project success (sections 7, 8 and 9).

Please note that this guide does not provide a comprehensive answer to all the questions and issues that visitor use management currently raises. It is based on experience acquired with the indicators used by Port-Cros National Park to gain insight into and assess visitor use on its territory. It does not aim to implement a tourist management plan but, through concrete experience, developed in the boxes, to demonstrate how good knowledge of visitor use can help identify and specify management measures.

A few additional methodological references for visitor use monitoring

Cessford, G. & Muhar, A., 2003 - Monitoring options for numbers in national parks and protected areas. *Journal of Nature Conservation*, no. 11, pp. 240-250.

Eagles, P.F.J., et al., 2002 - *Sustainable tourism in Protected Areas. Guidelines for planning and management.* IUCN Gland, Switzerland and Cambridge, UK, 183 p.

Griffin, T., et al., 2010 - *Protected area management: collection and use of visitor data: Vol. 1, summary and recommendations*. CRC for Sustainable Tourism, Gold Coast, Qld., 50 p.

Hornback, K.E., Eagles, P.F.J., 1999 - *Guidelines for public use measurement and reporting at parks and protected areas.* IUCN, Gland, Switzerland and Cambridge, UK, 90 p.

Kajala, L., et al., 2007 - *Visitor monitoring in nature areas - a manual based on experiences from the Nordic and Baltic countries.* Swedish Environmental Protection Agency, Stockholm, 207 p.

Bateaux au mouillage dans la baie de Göcek (Turquie). © Credit : Özge Can

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2. Devising the project

Studying human use of a marine protected area does not simply amount to counting people or boats. A strategy must be implemented for the acquisition and processing of data necessary to achieve clear, consistent management goals.

2.1 Defining the goals of the visitor use monitoring project

2.1.1 Four key questions

First, the management entity's challenges and expectations in respect of visitor use knowledge must be identified. A visitor use study is frequently carried out without first defining clear goals. The results are subsequently not relevant and are difficult to use for management purposes.

Four questions provide a framework for the project's main goals :

- What management problems does visitor use raise in the MPA?
- What are the visitor use management objectives in the MPA?
- Which information should the project provide to understand visitor uses that cause the problems?
- Which existing information can be used for the project?

Information already available and the data obtained through the project will not be sufficient in themselves for decision-making. However, they will provide input for reflection on the implementation of appropriate management measures.

Defining the project goals: 2 examples

"There are too many visitors at my MPA and I want to restrict numbers."

The visitor monitoring project must provide data about the extent of visitor numbers and their distribution in space and time, the characteristics of uses and practices, user types and user perceptions of their own visit and other uses.

"Some remarkable birds nest in my MPA and I want to minimize risks of disturbance during the breeding period."

The visitor use monitoring project should help quantify visitor flows at the nesting sites, measure variations in visitor use during the nesting period, obtain data about users and their activities and the reasons behind their practices on the nesting sites, and assess their knowledge of birds and their perception of the avifauna and disturbances.

2.1.2 Advice

To obtain a global vision of an MPA's visitor use, several studies may be necessary. It is important to ensure that they are complementary and coherent in terms of methodology. Les Calanques de Marseille National Park (in France) can provide evidence of this need for coordination. In twenty years, the managers and owner entities have carried out over 40 visitor use monitoring projects to quantify and qualify visitor numbers and use at some of the park's sites (eco-counters, surveys, interviews, visual counts on land and at sea, flow estimations, etc.). However, the studies do not relate to the same times of the year, they are based on different monitoring protocols or sometimes target specific uses (diving or climbing for instance), making all subsequent data compilation extremely complex. Other factors can complicate the analysis, such as multiple types of access and weather conditions for example.

2.2 Adapting requirements to resources

The question of the resources (financial, human and material resources, skills, possible partnerships, etc.) that the manager can invest in the monitoring project is a central issue. These resources will effectively influence the degree of precision, completeness and analysis of the data acquired.

Four levels of analysis can be determined. The higher the level, the more resources the monitoring project will demand.

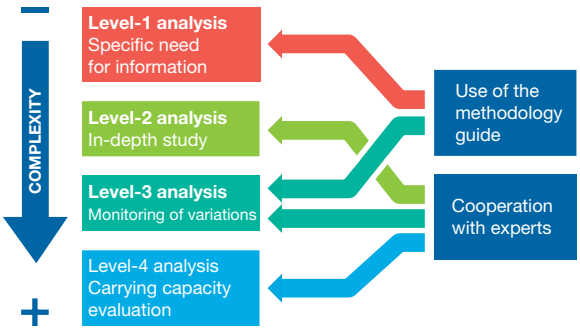

Figure 3 : Visitor use analysis levels.

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2.2.1 Level 1: a basic analysis to answer specific questions

The indicators proposed in this case can meet the requirement in a relatively short amount of time (1 to 2 years) and with fairly limited means depending on the site. These indicators are adapted to management entities that wish (or are only able) to use internal skills and means.

2.2.2 Level 2: a complete, in-depth analysis of visitor use

More complex topics will be addressed and/or complete visitor use data must be obtained to encompass all the quantitative, qualitative, behavioural and spatio-temporal aspects. This level of analysis is more expensive and more demanding: the required project duration is at least two years and use of skilled scientific teams and specialized research firms is often necessary.

2.2.3 Level 3: long-term monitoring

This level is appropriate for managers seeking to study trends and variations in visitor use over time, to plan for future changes. The monitoring project demands extensive resources and a specific organisation within the management entity: planning tasks and budgets, coordinating the monitoring, structuring information in dedicated databases, etc. This kind of study also requires a prior overview of visitor uses obtained by implementing the level 1 or 2 analysis. This is an essential prerequisite to be able to test and validate the indicators and methods developed for long-term monitoring. To successfully complete the various steps, the manager can rely on this methodological guidance but may also, in some cases, call on specific external skills (scientists, specialized research firms, etc.).

2.2.4 Level 4: need for carrying capacity evaluation

This level-4 analysis is the most complete but also the most complex to roll out. Not only does it demand extensive studies of visitor use and long-term monitoring, it also requires multi-disciplinary studies (biology, ecology, geography, sociology, economy, etc.). Engaging reflection on the carrying capacity largely builds on the visitor use analysis levels mentioned above. Work on carrying capacity most often demands specific abilities provided by scientific teams and specialized research firms. In this respect, we should point out that extensive work has been done in scientific spheres but that, given the great disparity of studies, they are not very operational for managers. This theme therefore remains exploratory and applies more particularly to specific management problems.

Determining the carrying capacity of a mooring site : the example of Gocek Bay in Turkey.

Turkey has 14 Special Environment Protection Areas. Fethiye-Gocek is the most suited to water-based recreational activities as it features many sheltered bays. There are several marinas in Gocek Bay which welcomes a significant number of boats from May to September, liable to generate major environmental disturbance. This finding prompted the territory manager to wonder about the Bay's carrying capacity in the face of developing water-based activity.

The studies launched on the site's carrying capacity led the managers to define a physical carrying capacity, an actual carrying capacity and lastly an effective carrying capacity.

The physical carrying capacity is obtained from a calculation of the possible number of boats that could be accommodated simultaneously based on the length of the wharfs and pontoons, the necessary clearance for each boat and their frequency of rotation. The actual carrying capacity is determined by deducting from the physical carrying capacity areas not suited to mooring (rocks, wet areas, etc.) or requiring protection (Posidonia oceanica beds, Cymodocea nodosa). Lastly, the effective carrying capacity factors in the site's management strategies and requirements (legislation, policies, available staff, budget, etc.).

The results of this approach show that Gocek Bay today has an effective carrying capacity of 1,111 boats. The fleet already present in the area includes 906 boats, which therefore greatly curbs all prospects of developing water-based activities.

As a result, the managers will focus in future on the development of local activities with little impact on the environment.

Reference: Özden, G. B., 2008, *A complete study on the determination of yacht carrying capacity in Gocek Bay (Fethiye-Göcek Special Environment Protection Area)*, in Conference on Marine Problems and Specific Solutions, COMPASS 2008, Maldives, June 15-17-2008, pp. 151-159

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3. Determining your MPA

MPAs in the MedPAN network are extremely diverse, both in terms of geographic features and their protection statuses and management policies. This diversity impacts human activity and must be taken into consideration in the visitor monitoring project.

3.1 Typology based on geographic criteria

The survey carried out in 2007 shows that 47% of the MPAs are in island or archipelagic locations and 32% include a continental or island-based land part. These particular geographic characteristics greatly determine the volume, type and organisation of tourist flows and the ways in which visitor use can be monitored.

To determine the most appropriate visitor use monitoring indicators for each MPA, a typology has been developed based on geographic criteria.

3.2 Four MPA types; four indicator adjustment models

3.2.1 Type 1 : Exclusively marine MPA

These are open areas of the sea with no physical, structuring, land-based features (bay, beach, harbour, etc.). The distribution of uses is therefore complex to study as they are exclusively water-based and spread out at sea. This first type thus requires specific methods, particularly by air, which are currently the subject of specific research. The influence of certain factors on the use of these MPAs can nonetheless be measured: distance from the coast, population density and the level of facilities on the continent, environmental resources and climate patterns.

Nota Bene : There is currently no exclusively sea-based marine protected area in the MedPAN network.

3.2.2 Type 2 : Exclusively marine MPA adjacent to the continent or an island

This is an open area that can be reached from land or by the sea. To monitor visitor use, the adjacent island or continental parts must be taken into account, as they form a hub which generates visitor flows (pleasure or professional boats, divers, swimmers, etc.) directly linked to the MPA. For some indicators, it is therefore relevant and necessary to integrate the nearby coastal fringe.

Examples: Tabarca Marine Reserve (Spain), Côte Vermeille Marine Nature Park (France).

3.2.3 Type 3 : MPA including a portion of continental coastline or a portion of a large island (Sicily, Rhodes, Corsica, etc.)

This kind of MPA is located at the interface between two open spaces: one on land and the other at sea, with a broad range of activities and specific and interdependent visitor use patterns. This specificity means that land and sea-based monitoring indicators must be interlinked. All the MPA's borders are permeable and visitor flows into the MPA are often hard to pinpoint.

Examples: Les Calanques National Park (France), El Estrecho Natural Park (Spain), Strunjan Nature Reserve (Slovenia).

3.2.4 Type 4 : MPA including an island or an archipelago

Like types 1 and 2, these MPAs are disconnected from the continent but still under its influence. They consist of an open sea area and a finite land area. Visitor use of the MPA's land part is therefore fairly easy to tackle. However, in an archipelago, the geographic complexity can be problematic for visitor use monitoring, due to the island locations, the structural and functional diversity of each island and the network of exchanges that develops between them.

Examples: Montgri, Medes Islands and Baix Ter Natural Park (Spain), Port-Cros National Park (France), Kornati National Park (Croatia), Galite Archipelago National Park (Tunisia), Palm Island Nature Reserve (Lebanon).

Type 4 MPA, Cabrera Archipelago Maritime-Terrestrial National Park in the Balearics (Spain). © Credit: Giorgio Gatti

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4. Selecting and adapting your indicators

The suggested indicators allow the various aspects of visitor use in MPAs to be studied in a standardized manner. The information obtained with these indicators will be all the more relevant if they are correctly selected and adapted to the manager's project.

4.1 Presentation of the indicators

Eighteen indicators for monitoring visitor use of Mediterranean MPAs are proposed and organised in five categories (chapter 5).

Quantitative indicators	5.1 Water and waste
	5.2 Passenger transport by sea
	5.3 Road and path use
	5.4 Moorage area use
	5.5 Recreational fishing site use
	5.6 Diving site use
Qualitative and behavioural indicators	5.7.1 User profiles and activities
	5.7.2 User perception and satisfaction
	5.7.3 Knowledge and perception of regulations
	5.8 Compliance with regulations
	5.9 Emerging activities and practices
Baseline data	5.10 Weather conditions
	5.11 Land-based accommodation capacity
	5.12 Capacity at sea
	5.13 Rental vehicle fleet
Safety indicator	5.14 Emergency response
Cross-disciplinary indicators	5.15.1 Visitor use / environment interaction
	5.15.2 Economic benefits of visitor use

Table 2 : Visitor use monitoring indicators

4.1.1 Quantitative indicators

The six quantitative indicators provide fundamental numerical data for any visitor use monitoring project and studies into its management. These indicators provide an evaluation of the extent of visitor use, the distribution of various uses in time and space, and the dynamics of visitor flows.

In some cases, quantitative data already exists and can be obtained from competent organisations. However, manual or automated counts generally need to be done across the entire MPA or a portion of it. Tools include handheld counters or they may be automated like eco-counters.

Manual count of boats mooring in Morgiou calanque, Les Calanques National Park in France. © Credit: Parc National des Calanques

4.1.2 Qualitative and behavioural indicators

The five qualitative and behavioural indicators determine the characteristics of MPA users and their practices. They also deliver knowledge of their expectations, perceptions and degree of satisfaction. This information is particularly important to subsequently adapt the management of these groups or prevent any conflicts between uses. It is also vital for good interpretation of the quantitative results.

In most cases, surveys among the various user categories will be needed for these indicators. Particular attention must be paid when designing surveys to avoid all bias in the questionnaire and the interpretation of results. Assistance from an expert in human and social sciences will be necessary.

4.1.3 Baseline data

By measuring a number of variables and factors that influence MPA use, the four baseline data indicators (weather conditions, land and sea accommodation capacities, rental fleet) provide vital insight for understanding the quantitative, qualitative and behavioural indicators.

Such baseline data is very often obtained from competent organisations (tourist boards, meteorological agencies, port authorities, etc.).

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4.1.4 Safety indicator

Safety is often a major concern for MPA managers, particularly in summer (fires, site health status, etc.). This indicator integrates this concept which relates to natural factors, extent of visitor use and user activities and behaviour.

4.1.5 Cross-disciplinary indicators

These indicators aim to evaluate interactions with the environment and the economic repercussions of visitor attendance. They demand in-depth analysis. They can very often only be implemented as part of research work involving managers and experts in sociology, ecology, geography, economics and biology.

4.2 Selecting your indicators

To study visitor use of an MPA, not all the indicators proposed in this document need necessarily be monitored. The four key questions below can help define the priority indicators for the study, for appropriate investment in time and resources and optimal success.

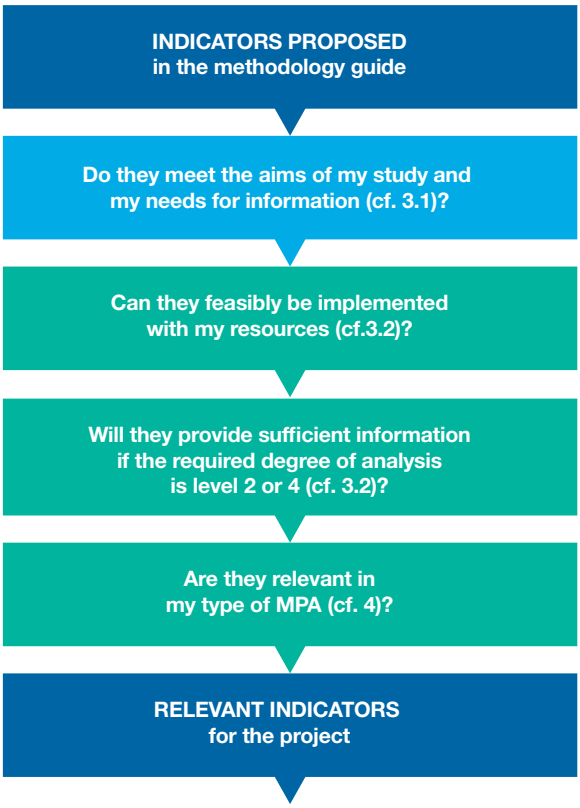

Figure 4 : Visitor use study and monitoring indicator selection criteria.

Some indicators may be crossed to provide new information. In this way, even a small number of indicators can provide broad possibilities in terms of data processing and analysis.

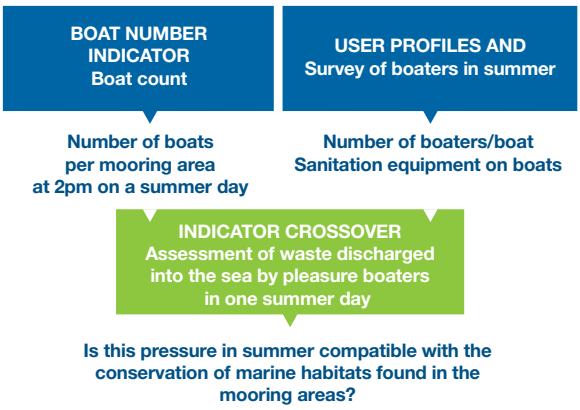

Figure 5 : Example of indicator crossover.

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4.3 Datasheets for adapting indicators to your MPA

The indicator datasheets presented in detail in chapter 5 have been prepared so that managers can :

- assess indicator relevance he based on the visitor use issue and the information they require;
- have a framework protocol to adjust the indicator to the MPA, to the knowledge required, to the required degree of analysis and to available resources. The framework protocol establishes the basic methodology in terms of the type of data gathered, the collection method, the frequency, and the location. It also provides indications about the data collection period and average cost. In some cases, several framework protocols are proposed;
- assess the feasibility of implementing indicators at their site, and plan any cooperation or anticipate any difficulties.

Managers can draw up their own indicator datasheets based on the structure of those presented in this guide.

4.4 Difficulties often encountered when selecting and adapting indicators

Managers very often find themselves faced with :

- too many indicators that are too complex to use;
- scientific monitoring goals not aligned with the concerns of the teams tasked with the study in the field.
- The guidelines below will help to avoid certain errors when selecting indicators:
- re-specify the visitor use monitoring project and always keep the required level of analysis in mind (level 1, 2, 3 or 4);
- avoid pursuing scientific goals without expert assistance;
- build partnerships with stakeholders interested in the project (local associations, scientists, users, etc.). By involving them in your study, ideas can emerge to jointly develop and implement the operational indicators;
- develop simple data collection protocols for each indicator and only gather strictly necessary information;
- when monitoring indicators over time, regularly adjust them to changes in site uses and emerging management issues.

5. Indicators

Based on the requirements defined by the manager, the indicators may be implemented separately or in connection with other indicators. An indicator may be used on a one-off basis or reproduced to monitor variations in visitor use.

5.1 Water and waste indicator

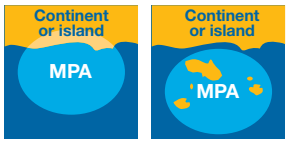
5.1.1 Relevance

Indirect evaluation of visitor use and consumption behaviour

Water and waste management is a key component of problems inherent in coastal and island tourism in MPAs. This indicator provides data on :

- The amount of water consumed in the MPA; it also monitors the ratio between water consumption and the status of the resource.
- The volume of wastewater treated in plants, mainly generated by domestic and tourist uses in coastal and island areas.
- Quantities of waste collected in the MPA.
- This indicator also provides information about MPA user behaviour with respect to the environment and consumption modes (water saving principles, purchasing of packaged products, etc.).

5.1.2 Relevant MPA types



5.1.3 Framework protocols

a/ Existing data collection

Data collected : Monthly volumes of water consumed and treated, monthly tonnage of waste collected.

Collection method : Collection of pre-processed data from entities responsible for water supply, water treatment and waste collection. This method requires a partnership with these organisations to ensure continuous data transmission.

Frequency : Contact with organisations once a year.

Time and cost : one day of work by one person to contact the organisations and archive the data.

Archiving : Excel©-type spreadsheet.

b/ Evaluation of macro-waste quantities on beaches

This protocol is relevant if beach waste management is a major problem for the manager and no data is available to quantify the waste.

Data collected : Volumes of macro-waste collected.

Collection method : Manual collection of macro-waste and measurement of the volume and types of macro-waste using calibrated containers (dustbin bags for example).

Frequency : Daily on a small beach representative of the MPA to evaluate the annual or summer season volume. If the collection concerns the entire MPA, a collection campaign provides an order of magnitude of the amount of macro-waste. Five campaigns during a summer are necessary to assess variations between summer seasons.

Time and cost : For a small representative beach, daily collection can be combined with a site surveillance patrol. Large-scale waste collection campaigns are more labour-consuming. Volunteers may be involved and campaigns can thus be integrated into public awareness actions.

Archiving : Excel©-type spreadsheet.

Macro-waste collection by hand, Zakynthos National Park (Greece).
© Credit: Jean-Pierre de Palma

5.1.4 Advice

When archiving the data, specify any unusual event that may significantly affect volumes of water or the waste tonnage during the year, such as system leakages, a fire, construction work, a container running aground, etc.

This indicator does not lead to a precise evaluation of the extent of visitor use, but allows the main trends to be assessed. It can be combined with indicators that directly quantify visitor use to obtain information about user consumption patterns.

The amount of waste measured on a beach is not solely generated by the people visiting the site. Waste can also come from more distant areas and be carried by the sea's currents.

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5.2 Passenger transport by sea indicator

Count of passengers arriving by the transport boats in Port-Cros National Park (France)

Seven companies carry passengers to Port-Cros Island in the summer season, and two in winter. Passenger traffic has considerably increased since the 1970s. Approximately 10,000 visitors once disembarked on Port-Cros each year, whereas that number is around 100,000 today.

Visitor numbers and variations are at the centre of reflection on sustainable tourism on Port-Cros. In 2002, the National Park began monitoring passenger traffic each year as part of the Bountîles visitor observatory. Monthly visitor data is provided by the passenger transport companies, but this data is often incomplete and difficult to interpret. It has nonetheless shown that, since the year 2000, the number of passengers disembarking each year has stabilised and that 50% of passenger traffic occurs in July and August.

This information is completed by significant daily monitoring efforts, vital to conduct studies into operational visitor management. The manager, visitors and retailers all indeed have varying perceptions of daily visitor use and greater objectivity is required for work to progress. Visitor numbers can only be obtained by means of manual counts. These counts are done in July and August by the Park's staff, with the help of trainees and seasonal workers, using simple handheld counters, from 8:40am to 5pm.

Thanks to the high number of counting days (30 to 62 days each summer), a real statistical analysis of variations can be done; it confirms the daily stability of traffic recorded on an annual basis. In addition, peaks in visitor numbers that are systematically recorded in August vary around a mean value of 1,756 disembarking passengers.

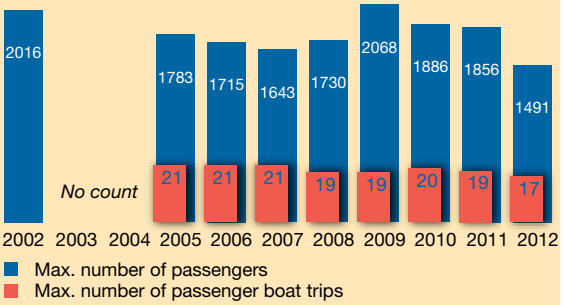


Figure 6 : Maximum journalier de passagers débarqués par les navettes à Port-Cros entre 2004 et 2012.
Source : Bountîles Port-Cros, LETG Brest-Géomer

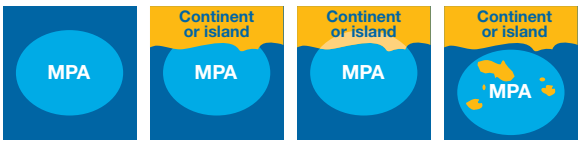
5.2.1 Relevance

Direct evaluation of organised passenger transport by sea

The data for this indicator is essential and forms the basis of any MPA visitor use monitoring study. It enables a direct evaluation of :

- the number of passengers disembarking on the land-based areas of an MPA;
- the number of passengers transiting within the marine area of the MPA,
- the maritime flows linked to passenger carriage.

5.2.2 Relevant MPA types



5.2.3 Framework protocols

a/ Data collection from passenger transport companies

Data collected : Number of passengers carried each month by the passenger transport companies.

Collection method : Contact with the companies to collect the monthly data.

Frequency : Monthly data collected once a year.

Time and cost : One half-day of working time to collect and archive the monthly data.

Archiving : spreadsheet (such as Excel©).

b/ Daily manual counts

Data collected : Number of passengers carried each day by the transport companies.

Collection method : Specific counts on typical days to obtain daily data (difficult to obtain from the passenger transport companies).

Passengers can be counted by one or more spotters, equipped with a handheld counter and a structured form to report the time and place of the count, the number of passengers, and the number of passenger boats. If necessary, the count may differentiate the various passenger categories (those bringing diving or hiking equipment, etc.). This distinction makes the count more complex but provides an initial qualification of visitor use.

Location : The specific counts are carried out on all the quays used by the passenger shipping companies transiting in the MPA. Passengers are counted either when they embark or when they disembark. The same method must be applied for all counting operations. Spotters

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must be strategically positioned to be able to count visitors one by one, as they board or leave the boat, in a regular stream, without seeking to anticipate their passing.

Frequency : The number of days of counts shall be adapted to the site's specific features and the required degree of analysis (at least five days at the height of the summer season). The days shall be chosen to be representative of the monitoring period, particularly in terms of weather conditions, days of the week, the calendar of festivities, etc.

Time and cost : The cost depends on the working time spent by staff involved in the operation. The time will vary with the number of sea links, the frequency of trips and the number of counting sites. Each operation should be done for a full day from the first to the last boat. A field agent may need to work overtime to cover a full day at certain sites.

Archiving : Archiving can be done on a spreadsheet (such as Excel©). A database should be created if there is a lot of counting data (multiple counting points and indicator monitoring over several years).

Débarquement d'excursionnistes à Porquerolles.
© Crédit : LETG Brest-Géomer UMR 6554

COMPTAGES DES DÉBARQUEMENTS

Date :
Observateur :
Total débarquements :

compagnie	nom du bateau	heure arrivée	nb passagers	groupes	chiens	palmes

Remarques, qualification de la journée (météo, attitude des gens, événements...)

Figure 7 : Passenger disembarkation counting card used in Port-Cros as part of the Bountîles observatory
Source : Bountîles Port-Cros, LETG Brest-Géomer UMR 6554

5.2.4 Advice

Monthly passenger numbers can only be obtained through close collaboration between the MPA manager and the passenger transport companies.

Depending on the site, the number of passengers carried includes visitors, plus a non-tourist population of residents and professionals.

Passenger transport by sea includes activities that require the use of private navigation means put in place for specific purposes such as whale watching and bird watching.

Passenger transport by sea without disembarkation

In certain marine protected areas which may include a land-based area, passenger transport companies travel over the marine protected area without the passengers disembarking.

This is the case in Les Calanques National Park in France. Some forty ferry companies, operating out of 10 ports, carry passengers who stay on board throughout the trip to discover the park. In this case, an approximate monthly number of passengers carried by the companies is sufficient. The main information is the number of trips done by the companies in the calanques area.

5.2.5 Example of a management measure

In island areas, it is often difficult to guarantee visitor safety above a certain visitor number threshold. Moreover, tourism industry professionals often feel they are unable to work correctly (insufficient number of bicycles, long queues in restaurants, etc.). Precise knowledge of visitor numbers therefore allows these peaks to be calibrated and, in consultation with stakeholders in the area, arrangements may be made to restrict the number of passenger boat trips during very busy periods.

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5.3 Road and path use indicator

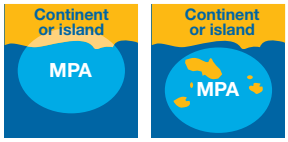
5.3.1 Relevance

Évaluation des flux de fréquentation piétonne, cycliste et motorisée

This indicator determines the characteristics of visitor flows in the MPA's land-based parts by providing :

- quantitative information (numbers on roads and lanes);
- qualitative information (means used to get around and identification of "multi-use" roads),
- data concerning the spatio-temporal distribution of visitors (points of traffic congestion, seasonal and daily variations, peak hours, etc.).

5.3.2 Relevant MPA types



5.3.3 Framework protocols

a/ Automatic count system reading

Automatic counters should be preferred, particularly for monitoring purposes, as they provide information continuously over the year and require few human resources.

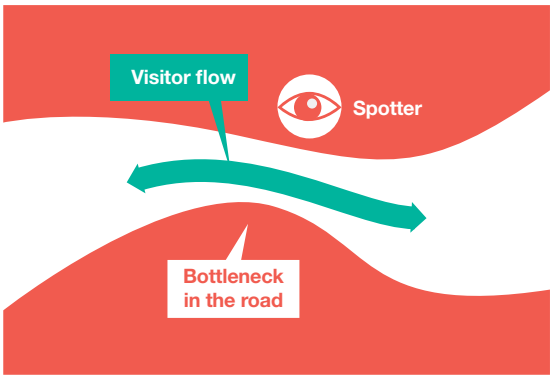
Data collected : Numbers passing per hour, day or month detected by an automatic counter (acoustic slab sensor buried beneath a path or pyro-electric sensor for walkers, magnetic loops for cyclists and vehicles on roads). With certain types of counter, the different direction of flows can be detected. This option can be used to record entries to a site but is not necessary to assess traffic on a road or lane.

Collection method : Data reading in situ using a handheld terminal or opt for a GSM or satellite reading system on a very large site for example.

Location : The counter installation plan (number, type and location) requires a prior study, and the objectives of the count must be very clearly defined. The number of counters should be based on the site configuration and on resources available for maintenance. Counters should preferably be installed on "typical" roads and lanes, representative of the MPA's land-based part.

Manual read of an eco-counter on Porquerolles Island (Port-Cros National Park, France). © Credit: LETG Brest-Géomer

Case 1 : Visitor count on a single road



Case 2 : Visitor count at a crossroads

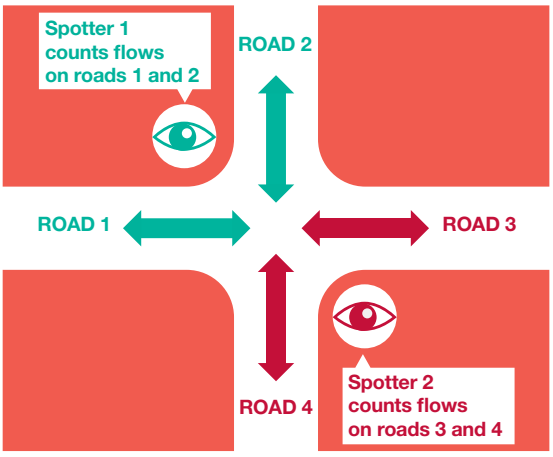


Figure 8 : Spotter location for visitor counts on land.

Frequency : Manual data reading should be done at least once a month in the high season and once a quarter in the low season. In the case of automatic data reading, equipment must still be monitored.

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Time and cost : This depends on the number and type of counter. The cost of a counter and a data reading and development system can range between €1,500 and €3,000 depending on the model and the performance. Allow at least one half-day of work by one person to manually read six counters.

Archiving : The data reading, archiving and development software supplied with the counting system should be used. When processing the data, a margin of error on the counters must be taken into account. Automatic counting systems are delivered with an equipment error margin which must be integrated into the data processing. In addition, on-site tests should be done to check that the counters are correctly installed and function properly. Such tests will sometimes reveal a different margin of error that must also be included in the data analysis.

b/ Manual counts

Manual counts are possible if automatic counters cannot be installed, or in the case of limited needs for information.

Data collected : Number of walkers, cyclists or vehicles on roads and paths per hour.

Collection method : Manual count of flows by a spotter. Handheld counters can be used where traffic is high or if the direction of flows needs distinguishing. Data is recorded on a count report form allowing flows to be qualified (walkers, cyclists, vehicles) by time slot and by direction where applicable.

Location : A prior study is necessary to define spotter locations, in the same way as automatic counters. The number of counting points should be restricted to six at the most. By a lane or a road, a spotter must be easily able to count all walkers or vehicles without anticipating their movement.

Frequency : The number of counting days is calculated based on the required representativeness of the results. It will depend on the required degree of analysis and the management problem at issue. Where flows along a path simply need evaluating, counts will be done on two or three days at the height of the summer season. If quantitative and qualitative data about flows in the vicinity of a nesting area is required for example, the number of counts will be increased during the sensitive nesting period.

Time and cost : The cost depends on the time spent by staff involved in the operation. The length of counting operations varies with the activities that generate the flows to be measured. For walking, the count will be done over a full day, to include early morning walkers through to the last main flows in the evening. All counting points should be observed on the same day. For each counting day, there should be as many spotters as there are counting points.

Archiving : Data can be archived in a spreadsheet (Excel© type). The most detailed data possible should be recorded to highlight hourly variations in flows.

5.3.4 Advice

Automatic counters require regular maintenance and careful monitoring: unobtrusive installation and reading, counter case sealing, early detection of any malfunctions, etc.

For long-term monitoring, a skilled person should be put in charge of the equipment. Automatic counters record a number of passing flows and not a number of passers-by. To count individuals, counters must be specifically distributed and this demands a prior detailed study of traffic on roads and paths.

Depending on their positions, automatic counters can provide qualitative information about certain activities. However, a manual count is more precise, although more tedious to do.

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5.3.5 Example of a management measure

By quantifying visitor flows along the MPA's roads and paths, it is possible for example to identify and locate daily visitor peaks. This data is used by managers to plan for any facility saturation problems (parking areas, paths, etc.) or to highlight significant visitor flows near environment-sensitive zones (quiet zones for wildlife, nesting sites, etc.).

The importance of coordinated protocols in visitor use monitoring: the example of Parcs nationaux de France

(L. Chabanis, Parcs nationaux de France)

National parks in France began conducting studies to estimate visitor numbers in 1996. The studies are done once every five years and in 2001, inter-park data processing became possible, using qualitative visitor information. For the 2011 counting campaign, the protocols were standardised between all the National Parks and were assessed by statisticians.

During the 2011 summer season (from June to September for Metropolitan France and from December to March for overseas regions), quantitative and qualitative data was collected based on a common protocol combining automatic counts on roads and paths and visual counts on paths and car parks.

Visual counts in parking areas can be use to determine a coefficient of the number of people per vehicle to turn a number of vehicles obtained by road counts into a number of visits. The National Parks' marine areas were also taken into consideration.

For the first time, both qualitative and quantitative visitor data relating to different protected areas can be processed.

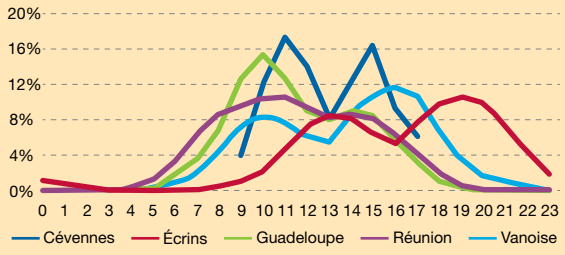

Figure 9 : Comparison of visitor flows in core areas of five French National Parks over 23 days in the 2011 high season.

5.4 Mooring area use indicator

Mooring area use monitoring on Porquerolles

(Port-Cros National Park, France)

Porquerolles Island (1,254 hectares) is part of the archipelago of the islands of Hyères, along with Port-Cros and the Levant islands. Accessible in just a few minutes by passenger boats and located in the heart of a particularly active boating area, Porquerolles attracts significant tourist numbers estimated at one million visitors per year.

Port-Cros National Park, which ensures the protection of the island's natural habitats and land and sea areas, decided to carry out a visitor monitoring project in 2002 to obtain precise data about people visiting the land and marine parts of Porquerolles and Port-Cros. Created in 2003, the Bountîles observatory (Base d'Observation des Usages Nautiques et Terrestres des Îles et des Littoraux) conducts quantitative and qualitative monitoring of visitors to the two islands.

In Porquerolles, boat numbers are monitored for the harbour by manual counts and yacht-night data obtained from the harbour master; for mooring areas, numbers are obtained by aerial views taken during ULM overflights.

The monitoring protocol applied since 2005 includes two overflights per summer season. These flights are done by a professional pilot and photographer who then send the photos to the National Park for processing. One overflight of Porquerolles provides a set of approximately 90 photographs to be located and analysed by hand (cf. next page photo). On each view, the boats are located, characterised (yacht/motor boat/inflatable, etc.) and measured (less than 6 metres, 6-10 metres, etc.) to populate an Access database linked to a layer of spatial data delimiting previously identified mooring areas (cf. figure 10).

The 2002 study counted a maximum of 1,712 boats in the mooring area and the harbour, on 18 August 2002 (vs. a maximum of 341 in Port-Cros, on 16 August 2002). With an average of 4.2 people on board, the number of recreational boaters travelling to Porquerolles Island is close to, or even higher on very busy days, than the number of people arriving by the passenger boats! The monitoring done by overflight between 2003 and 2011 did not reveal any significant increase in boat numbers (cf. figure 11). The result must, however, be weighted with the fact that the overflights are often scheduled with the pilot several weeks in advance and do not always take place on peak days.

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Aerial picture of Porquerolles, taken in August 2011.
© Credit : LETG Brest -Géomer UMR 6554

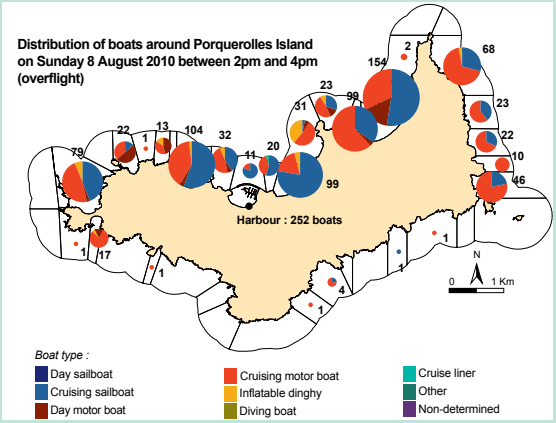


Figure 10 : Example of a map developed from an overflight.
Source: Bountîles Porquerolles, LETG Brest-Géomer UMR 6554

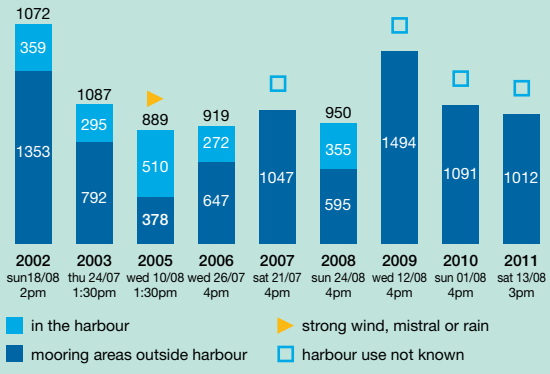


Figure 11 : Variation in boat numbers in Porquerolles from overflights done between 2002 and 2011. Source: Bountîles Porquerolles, LETG Brest-Géomer UMR 6554

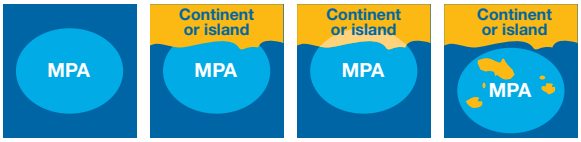
5.4.1 Relevance

Evaluation and monitoring of mooring area use at a time T

This indicator relates both to recreational boaters using organised mooring areas and anchorage users who are more difficult to count. It provides the following information :

- an evaluation of the extent of mooring area use (harbours, mooring areas, anchorage sites);
- hourly, weekly, seasonal and year-over-year variations (depending on the sampling strategy);
- spatial distribution of boats in the MPA;
- characteristics of the fleet.

5.4.2 Relevant MPA types



5.4.3 Framework protocols

a/ Oblique aerial photographs

This protocol requires an aircraft and is recommended for vast MPAs and/or those with no appropriate land-based viewpoint for effective counting. To apply this method, an overflight authorisation must first be obtained and any potential environmental impact of the operation must be checked (disturbance of wildlife in particular). It has the advantage of creating a photographic record of visitor use.

Data collected : Oblique aerial photos of mooring areas.

Collection method : Oblique aerial photographs taken from an ULM or a high-wing monoplane. Wide-angle views should be preferred. A digital camera with a minimum resolution of 6 million pixels makes post-processing zooming possible when interpreting the views. The aircraft will fly at an approximate altitude of 1,000 feet to be able to count and locate boats in a short amount of time. If boat sizes and types are to be determined based on a previously established typology, a second flight may be done at 500 feet.

Prior definition of a flight plan will avoid double counts and reduce the number of photographs needed.

In exclusively marine MPAs, with no land mark, high technology viewing equipment (onboard camera and geolocation tools) is necessary to spatialize the boats. Each view must include an easily identifiable portion of the coastal fringe in the background.

Location : The overflight covers all of the MPA's mooring areas based on a pre-defined flight plan.

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Frequency : At least three overflights in summer. Ideally, the flight will be scheduled during the day at a time when the boats are fairly immobile (meal times), or in the evening to assess the number staying overnight. For reasons of cost and interpretation, but also sound disturbance, multiple overflights should be avoided.

Time and cost : An overflight seldom lasts more than an hour for an average size MPA. The cost of the flight varies with the type of aircraft used: between €300 and €500 per hour for oblique aerial photographs, and more than €1,500 per hour for high technology pictures. The time required to interpret the photos and record the data (boat location and characteristics) depends on the chosen medium and level of analysis. In a very busy site (more than 1,000 boats), with a coastline of no more than 40 kilometres, allow one half-day of work to enter data in a simple spreadsheet, and a full day to create a layer of geospatial data. In the first case, boats are counted by mooring or sailing area whereas in the latter case, they can be identified by area or point by point (one point/one boat). This degree of detail is not always necessary and takes a lot of time when boat numbers are high.

Archiving : Data can be archived in an Excel©-type spreadsheet, or it may be necessary to create a Geographic Information System of boats for a deeper spatial analysis.

b/ Boat counts by observation from land or at sea

This type of count is easier to implement, less costly and therefore more reproducible than overflights. However, it is only possible in small MPAs or those with land-based panoramic viewpoints overlooking the mooring sites.

Data collected : Number and type of boats per mooring area.

Collection method : Boat counts by direct observation with data recorded by counting area and by type on a structured field report form. A prior study is necessary to delimit the counting sectors, based on geographic and use criteria, and to define a typology of boats.

Defining a typology of boats

The typology must be simple, reflect the boating practices specific to each MPA, and take management issues into account. It will depend on the resolution of photos when counts are done by overflight, and must not complicate observation for counts done from land or at sea.

Even if the characterization criteria are basic, the data archived should at least distinguish pleasure boats from professional craft. Within the category of pleasure boats, sailing boats and motor boats can be distinguished, as well as personal watercraft and other water vehicles (windsurfs, canoes, kite surfs).

It is often interesting to include the length of boats, due to the impact of large craft anchoring on the sea beds and the lack of sanitary equipment on the smallest boats.

Location : The count must be done at all of the MPA's mooring sites (whether organised or not). It can be done from one or more land-based viewpoints or from a boat, in which case the trip must be entirely dedicated to the count. It will be done by a spotter pilot and a second person to report the observations on the form during the trip.

Frequency : At least five counts per summer in comparable conditions, either early afternoon, when boats are relatively immobile, or in the evening to assess overnight stays. Unlike the overflight method, the counts may be done in moderate or poor weather conditions and the influence of these factors on boat numbers can be measured.

Time and cost : The cost depends on the working time spent by staff involved in the operation. The duration of the count will depend on the MPA's configuration, the size of mooring sites and the number of boats. It should not take longer than 90 minutes and be done when boats are fairly immobile, i.e. early morning, late evening or early afternoon. To reduce the time spent, it may be necessary to do the count with several boats or from several viewpoints at the same time. Field data capture on a computer storage medium takes less than an hour.

Archiving : a simple Excel©-type spreadsheet is recommended.

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Observation		Mooring area	Boats		
Date	Time		Type	Length	Nb
03/08/11	2-3pm	1	Recreational	<6m	6
03/08/11	2-3pm	1	Recreational	6-15m	3
03/08/11	2-3pm	1	Watercraft	>6m	1
03/08/11	2-3pm	1	Other vehicle	<6m	4
03/08/11	2-3pm	1	Professional	>15m	1
03/08/11	2-3pm	2	Recreational	<6m	7
03/08/11	2-3pm	2	Professional	6-15m	2

Table 3 : Example of a spreadsheet recording boats observed.

c/ Number of overnight stays in organised mooring sites

This protocol only applies to MPAs with organised, managed mooring areas, either with buoys or at the pontoon in a harbour.

Data collected : Number of overnight stays per month or per day.

Collection method : Data is collected from the entity managing the mooring areas. If the manager is not able to provide the number of overnight stays, specific counts can be planned. Counting staff must then be familiar with the counting methodologies and typologies applicable from a land-based viewpoint or at sea.

Frequency : Data is obtained once a year.

Time and cost : One half-day of work is sufficient to obtain and archive monthly data.

Archiving : in an Excel©-type spreadsheet.

5.4.4 Advice

Irrespective of the protocol chosen, if several spotters are involved in the boat monitoring study, they should receive prior training in the typology of boats to ensure that results are consistent.

When boat numbers are high, the mooring area should be broken down virtually, to minimise risks of error. Working along counting lines perpendicular to the coast, the number of boats on either side of the line is counted, before moving to the next line.

To model the results of boat counts, whether done by overflight or otherwise, in order to calculate annual numbers, many samples are necessary at different times of day and in varying conditions of use. Before initiating such a project, it is worthwhile spending time defining the maximum use of mooring areas during the day in the summer season.

5.4.5 Example of a management measure

Monitoring boat visits in space and time by counting operations (in situ or by overflight) provides concrete data that is useful for management. It can then be used to gauge the size of waste bins on islands for example. In Port-Cros, this information revealed significant congestion in mooring areas on certain days, prompting boaters to moor very near the beaches. It also highlighted the development of large yachts. As a result, the manager developed specific facilities and regulations applicable to mooring and swimming areas to preserve the natural environments and restrict conflicts between visitor uses.

Boat counts in the Debeli rtic Natural Monument MPA in Slovenia

The Debeli rtic Natural Monument MPA in Slovenia is mainly visited by pleasure boats that anchor around the peninsula. To protect the Posidonia seagrass beds, plans were made to lay out organised mooring areas. A boat count was done during the summer 2011, every two weeks at the weekend. The counts were done from the top of the cliff. To decide on the best place for the future environmentally-friendly mooring areas in the MPA, a short questionnaire designed for pleasure boaters was put online on the Institute's website. The aim was to gather the boaters' views of the development of mooring systems within marine protected areas.

The survey showed that the vast majority of respondents (over 90%) were aware of the negative impact of anchoring on the sea bed. More than 65% had heard of "eco-friendly mooring systems" and confirmed that, if such a system were available in a protected area, they would prefer it to anchoring. Over 50% said they would be prepared to pay a fee to use the mooring buoys, depending on the amount charged, naturally.

The success of conservation measures is often contingent on having the support of the local population; data collected therefore provides a very useful basis for the mooring system development project in Debeli rtic marine protected area.

Boats mooring in the Debeli rtic Natural Monument MPA in Slovenia.
© Credit : Alenka Popic

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5.5 Recreational fishing site use indicator

5.5.1 Relevance

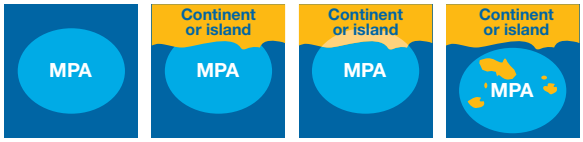
Evaluation of the extent of recreational fishing activities

Knowledge of pressure caused by recreational fishing is often a core aspect of MPA management. This indicator provides a quantitative and spatial assessment of the activity. To determine the characteristics of the pressure generated, qualitative indicators on fishermen's profiles and activities, their fishing patterns and regulatory compliance must be combined.

This indicator relates to recreational fishing activities carried out in the MPA, from the shore or from a boat. This indicator is therefore closely but not exactly linked to the boat use indicator.

Recreational fishing activities may be supervised by professional entities or associations, and done as part of competitions or individually. Fishing gear and techniques vary greatly, depending on the targeted species, resources and local practices.

5.5.2 Relevant MPA types



5.5.3 Framework protocols

a/ Counts by observation

This protocol delivers information about the number of recreational fishing boats at a time T and the number of fishermen doing the activity on the coastline. It can be pooled with counting operations in mooring areas (cf. indicator 5.4), provided that :

- The time of the count is adapted;
- Fishing from the coast is distinguished from boat-based fishing;
- Fishing gear is identified (rods, longlines, nets, traps, etc.);
- Counts are not solely limited to mooring areas.

Data collected : Number of recreational fishing boats in activity and number of active fishermen on the coast.

Collection method : Counts of boats (cf. indicator 5.4) and shoreline fishermen.

Location : The entire MPA for a full view, or selected, representative fishing spots.

Frequency : For a basic analysis, at least five counts per summer over the same counting area. In some cases, and depending on local fishing practices, several counts may be done on the same day.

Time and cost : The cost depends on the working time spent by staff involved in the operation. If the count covers the entire MPA, it should be done in less than one hour. Spotters should be given prior training for the operation. Allow one hour of work at the most for data archiving.

Archiving : Data can be archived in an Excel©-type spreadsheet, or it may be necessary to create a Geographic Information System of recreational fishing for a deeper spatial analysis.

Recreational fisherman in the future Katic marine protected area (Montenegro).
© Credit : Milena Tempesta

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5.5.4 Advice

Catches in the MPA are not solely due to recreational fishing. Inclusion of professional fishing activities is not presented in this guide. It is closely related to the structure of fisheries on a national and local scale and is extremely varied in the Mediterranean.

This indicator does not measure interactions between recreational fishing activities and marine resources. Only a multidisciplinary approach conducted with biology and environmental experts will highlight any impacts. This type of approach will be presented in detail in point 5.15.

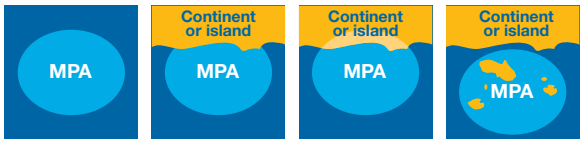
5.6 Diving site use indicator

5.6.1 Relevance

Evaluation of the extent of diving activities

This indicator relates to snorkelling, harpoon fishing, and deep-sea exploration diving, whether these activities are done individually or with a club. It provides data about the extent and distribution of the activities in the MPA.

5.6.2 Relevant MPA types



5.6.3 Framework protocols

a/ Counts by observation

This protocol provides the number of snorkelers or divers' boats in diving spots at a given time T. It can be pooled with counting operations in mooring areas (cf. indicator 5.4), provided that :

- the counting area delimitation includes diving locations,
- the typology of boats distinguishes between professional diving boats and those of individual divers.

Data collected : Number of divers' boats (pleasure boats or diving clubs), or snorkelers in diving spots.

Collection method : Counts of boats (cf. indicator 5.4) or snorkelers (easy to spot thanks to their snorkels, buoys and indicator flags).

Location : All of the MPA's diving sites for a full view, or selected representative diving sites.

Frequency : For a basic analysis, at least five counts per summer over the same counting area.

Time and cost : The cost depends on the working time spent by staff involved in the operation. If the count covers the entire MPA, it should be done in less than one hour. Spotters should be given prior training for the operation. Allow one hour of work at the most for data archiving.

Archiving : Data can be archived in an Excel©-type spreadsheet, or it may be necessary to create a Geographic Information System of diving site use for a deeper spatial analysis.

Divers and coralligeneous. © Credit : Harmelin J.G.

b/ Data collection of diving charter signatures

Individual diving practices are particularly difficult to assess due to the dispersal of divers in time and space. Requiring individuals to sign a charter of best diving practices would appear the most effective way of assessing diver numbers in MPA waters.

Data collected : Monthly number of diving charter signatures.

Collection method : Collection of charter signatures.

Frequency : Once a year.

Time and cost : One half-day of work to collect and archive the data.

Archiving : Excel©-type spreadsheet

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What is a diving charter?
(O. Musard, Agence des Aires Marines Protégées)

For about a decade, divers have been positioned as responsible players. Diving charters reflect this positioning as contractual partnership instruments between the users and managers of an MPA. They remind divers of a number of fundamental aspects, but place the emphasis on adopting impact-free diving behaviour, advisable diving site access control (with annual communication of figures), reporting of specific environmental information and risks incurred by failing to respect the undertakings. In return, voluntary commitment is given recognition and mooring points are generally provided, when access to the MPA is not contingent upon signing the charter, like in Port-Cros, the only case so far. A charter indeed changes according to the needs of each of the partners. It cannot be imposed; it is jointly developed and either adopted or refused, without any obligation. These changes are also very interesting to assess.

Reference : Dalias N., Lenfant P., Licari M.L., Bardelletti C., 2007. *Guide d'aide à la gestion des Aires Marines Protégées : gestion et suivi de l'activité de plongée sous-marine.* Document published by the Conseil Général des Pyrénées-Orientales as part of the Interreg IIIC MEDPAN programme. Conseil Général des Pyrénées Orientales - EPHE - OCEANIDE Contract. 62 pages + appendices

c/ Number of dives by clubs

At the very least, this protocol requires the establishment of a partnership with diving clubs. Data transfer can be facilitated by introducing a charter of best practices with these professionals.

Data collected : Monthly number of dives done by clubs.

Collection method : Contact with diving clubs.

Frequency : Data collected once a year.

Time and cost : One day of work to contact the clubs and archive the data.

Archiving : Excel© type spreadsheet.

5.6.4 Advice

The number of charters signed does not necessarily indicate the number of dives done in the MPA as, in some cases, it is not a requirement to sign the charter before each dive. The commitment may be valid for a full year for example, in which case the signing party can dive on several occasions.

We firmly recommend completing the quantitative approach with a qualitative approach as surveys or interviews provide more detailed information about divers' practices, their loyalty to the site and their diving spots.

Medes islands archipelago (Spain).
© Credit: Montgrí, Medes islands and Baix Ter Natural Park

5.6.5 Example of a management measure

Monitoring diving activities in Port-Cros National Park provided the manager with the necessary information to initiate a consultation process with diving clubs operating in the MPA. This initiative led to a veritable partnership with the introduction of a diving charter. Diving operators thus commit to promoting practices more respectful of the vulnerable marine environment to guarantee the continuity, or even development, of their activity.

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Gaining knowledge to improve management of diving activities and their impacts: the example of the Medes Islands MPA (Montgrí, Medes islands and Baix Ter Natural Park - Spain)

Located less than one kilometre off the coast of Estartit holiday resort in Spain, the Medes Islands have long been a very popular diving spot in the Mediterranean. Introduced in 1990, a Use Plan and specific regulations govern the activity to avoid all excessive diving and all potential harm to the outstanding offshore environment. Facilities and measures to control numbers have been put in place, restricting the number of divers to 450 per day, all year round, across the 10 diving sites specifically laid out (fixed mooring facilities). However, to improve management of the activity, in recent years the managers were keen to have qualitative data about divers' use of the marine area. A study was therefore carried out in cooperation with the diving centres to precisely identify the diving trails, the way dives are conducted and the benthic communities they like to explore.

The results were obtained through 88 exploratory dives and group monitoring over one summer. In addition to identifying general diving characteristics in the Medes (average depth of 26.7 metres, lasting 51 minutes, covering an average distance of 485 metres), the study of divers' use of the area is particularly interesting in terms of management. It showed that divers use almost 8 of the 51 hectares protected. This information provides a lead for studying changes to certain species based on the degree of diver use. Moreover, species indicative of a low rate of use were identified. The study also revealed that caves have the highest environmental risk factor (link between diver presence and vulnerability), while 37% of dives in the Medes take place in that kind of environment. The organisation of diving therefore needs to be managed based on the risk factor. Lastly, the study highlighted the importance of awareness-raising and information provided by diving clubs to reduce the activity's impact on benthic communities.

Reference : Núria Muñoz, 2007, *Spatial use and divers' behaviour in the Medes Islands*, field study, MedPAN report, 137 p.

5.7 Qualitative monitoring indicators by user surveys

Using a common protocol, a survey by questionnaire provides data for three indicators. The qualitative data obtained is essential to determine the characteristics of users, their activities, their opinions and their stance with respect to the MPA regulations. They relate to the different categories of MPA users (pleasure boaters, boat transport passengers, divers, etc.), whether visitors or locals.

Distribution of a questionnaire (multiple choice questions) on Port-Cros harbour (France). © Credit: LETG Brest-Géomer.

5.7.1 Relevance of the User profiles and activities indicator

This indicator aims firstly to identify the characteristics of user populations in the MPA: age, socio-professional group, main place of residence, place and length of stay, loyalty to the site (number of previous visits, date of the first visit, desire to come back), means of transport, etc. All this information is particularly useful for implementing effective communication.

Secondly, it provides understanding of user centres of interest (relaxation, nature discovery, fishing, sailing, museums, restaurants, etc.) and the activities they do. An analysis of this data will aim to assess the degree to which the activities actually done match visitor expectations, and to highlight the MPA's main centres of attraction.

5.7.2 Relevance of the User perception and satisfaction indicator

This indicator is designed to assess user satisfaction with respect to the activities they have done, the quality of services available (or not), and their opinion of the landscape and the environment, etc.

It also aims to define the relationships that exist between MPA users through two key questions :

- Would you say that the number of visitors to the site is :

  ☐ high ☐ medium ☐ low ?

- Do you find visitor numbers :

  ☐ acceptable ☐ inconvenient ☐ no opinion ?

These questions may be asked about the entire MPA or target one or more specific areas (diving sites, beaches, mooring sites, coastline paths, etc.). This indicator also measures user tolerance of visitor numbers and highlights any conflicts of use.

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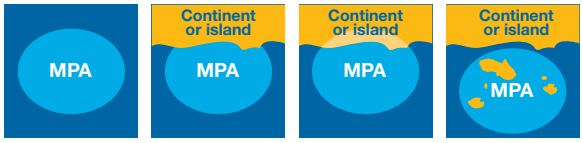
5.7.3 Relevance of the Knowledge and perception of regulations indicator

This indicator reveals the rules that visitors can remember and indirectly reports on the efficiency of MPA regulation communication. Two easy and inseparable questions provide the data :

- Are you aware that rules and regulations apply in the MPA ? ☐ yes ☐ no
- Can you state the rules you can remember ? (open-ended question)
- It also assesses how obligatory visitors consider the regulations to be (rules regarded as too ☐ restrictive/ ☐ justified/ ☐ no opinion). This perception can be correlated with the Regulatory compliance indicator for further knowledge of reasons for offences.

5.7.4 Relevant MPA types



5.7.5 Framework protocol

The survey protocol recommended to collect the qualitative data consists in handing out multiple-choice questionnaires, which are easier to do and analyse than interviews. However, use of multiple-choice questionnaires demands a careful approach and certain precautions to restrict bias. It requires prior interviews to develop the survey, a test run to measure the relevance and feasibility, and a processing simulation stage.

Visitors complete the questionnaire themselves. It should merely comprise a series of mostly closed-ended questions and should not take more than about ten minutes to answer. The questionnaires can be distributed to various user categories, or target a single category based on the survey requirements.

The protocol developed in this guide is based on questionnaires being done face-to-face on the visitor site (either on paper or on digital pads). It is also possible to considering administering the questionnaires online via the internet but in this case the user category must be targeted (pleasure boaters in sailing parts, holiday home owners, etc.) and liable to visit the MPA. Preparatory work (information meeting, consultation) must therefore be done with the target user group to ensure that results are reliable.

Data collected : User responses to a multiple-choice questionnaire.

Collection method : Face-to-face distribution of a multiple-choice questionnaire by sessions of 25 to 50 questionnaires. Provide a pen and a solid support to write on, so that questionnaires are easier to complete when in paper format. When using digital pads, make sure there is a sufficient number (approximately 10). In this case, the data is directly integrated into a database (Excel© type), which considerably reduces all subsequent archiving time. However, depending on the type of respondents, the digital approach is not always appropriate particularly for a lot of questionnaires. Use of digital equipment is also not advisable for questionnaires handed out onboard boats.

The survey is distributed at random, with one questionnaire per family, boat or group of individuals and five at the most for organised groups or diving clubs. Availability is an important criterion in the choice of respondent.

Frequency : The frequency of distribution sessions varies with the required level of analysis. It is advisable, whatever the case, to limit distributions to the summer season, which is a busy time and often when problems are the most significant. Obtaining data over an entire year demands a considerable effort as part of a large-scale monitoring project.

Required analysis level	Min. number of questionnaires	Min. number of distribution sessions
Annual monitoring	150 questionnaires each summer	5
Two-year monitoring	250 questionnaires once every two summers	8
Specific study	500 questionnaires during the summer	10

Table 4 : Numbers and frequency of questionnaire distributions based on required level of analysis

These numbers and frequencies should be taken with precaution. Firstly, they must be adapted to the goals of the study to obtain a significant sample to do the required analysis (global or targeting a given user group).

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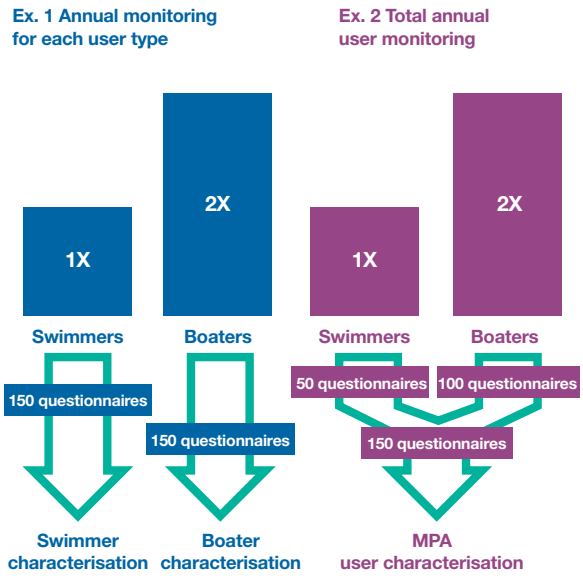

Figure 12 : Questionnaire distribution based on required type of analysis (for the whole group of users or for each user type)

Secondly, if use of the site is not significant and the numbers cannot be reached, statistical analyses are difficult to do. In this case, it is advisable to do the survey in the form of interviews every five to ten years.

Time and cost : They both depend on the distribution time, which varies with the number of sessions and the distribution site, and is longer to do at sea than on land. If a data capture interface is used, i.e. a spreadsheet for example, allow approximately three minutes per questionnaire for data entry.

Archiving : For print format questionnaires, the data can be entered in a spreadsheet (such as Excel©) with the questions in columns and the answers in rows (one question = one row). When using digital pads, it is vital to check that the questionnaires have been correctly filled in and that the automatically archived data is usable. Only consider using survey processing software if users are given prior training and where analysis requirements are high.

Implementing a qualitative study of tourist use in Cinque Terre National Park (Italy)

Listed as a UNESCO World Heritage site in 1997, Cinque Terre National Park comprises a marine part and covers a surface area of 4,300 hectares. It is Italy's smallest national park and is also under high human impact from a resident population of 5,000 inhabitants and considerable tourist activity. Yet, the park had very little data about visitors except for the official statistics of tourist-nights on its territory. Given the situation, in 2011 the managers launched a qualitative study into visitor use as part of a Tourism Watch project.

Riomaggiore village, Cinque Terre National Park (Italy).
© Credit : Cinque Terre National Park

The methodology implemented is based on two approaches : a netnography (inventory and analysis of websites) to find out the park's image on tourist websites and forums; and surveys using three kinds of questionnaire. The first is a short questionnaire designed to obtain visitor profiles while the second is longer and seeks to pinpoint motivations and perceptions. The surveys were done face-to-face by pollsters using digital pads on the park's beaches, pathways, and in the villages and train stations. A third questionnaire was posted via internet to assess the degree of visitor satisfaction following their visit to or holiday in Cinque Terre.

The first results of the survey already provide a wealth of information since they identify the characteristics of visitor populations and holiday home owners hitherto little known. The managers also appreciate having information about visitor knowledge and perception of the park and the regulations that apply in it.

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On a qualitative level, the surveys conducted between July and September 2011 showed that visitor numbers to the park in summer (314,345 visitors) are in fact almost twice the number estimated based on official tourist-night statistics. Visitors to the Cinque Terre National Park are mostly foreign and over 95% say they are very satisfied with their stay and would willingly recommend visiting the park to friends. In terms of adapting the territory's management, follow-up on the data is needed. Lastly, the method developed for Cinque Terre should be reproducible and adaptable to other parks or marine protected areas.

Conducting surveys by questionnaire among visitors at Manarola train station (Cinque Terre National Park - Italy). © Credit: Giovanni Riccard

5.7.6 Conducting a multiple-choice questionnaire

Developing the questionnaire :

- Develop a short questionnaire (less than 20 questions), with easily understandable content presented on one side of A4 paper. It must be answered by the respondent in less than 10 minutes. To achieve this goal, the design of the questionnaire must first be studied at length. It is advisable to draw up the questionnaire on the basis of a detailed visitor use survey.
- Prepare a list of "closed-ended" questions (a predetermined number of answers is suggested to the respondent) enhanced with a few "open-ended" questions (open response).
- Structure the questionnaire by categories of question, and do not jump from one category to another. The overall result must be coherent and logical for the respondent. Begin with general, fundamental questions and end with more personal questions (age, occupation, etc.).
- Write short and simple questions. Questions that are too long or unclear generate imprecise answers. Use appropriate terminology (non-expert) for the target respondent group, avoiding technical concepts and terms.
- Make sure questions are not biased. For example, the question "do you think it is important to protect the environment?" is biased as it calls for an expected answer: "yes".
- Adapt the survey questions to the target respondents (specific questions about diving for divers, about boats for boaters, etc.), but keep a common base of core questions so that comparisons between user groups are possible.

Administering the questionnaire in the field :

- Administer the questionnaire at the end of the visit where possible.
- Make sure the pollsters introduce themselves to respondents and explain the aims of the survey.
- Reassure users that the survey is anonymous.
- Stay close to respondents to answer any questions.
- To ensure that the survey is statistically appropriate and that results are representative :
  - › distribute the questionnaires at random with a certain degree of chance (for example, polling one pleasure boater in five in a mooring area);
  - › make sure that all user types have the same chance of being polled during the survey. To do that, vary the days and times of surveys but also take the different kinds of site access into account to avoid over- or under-representation of certain user groups;
  - › respect the recommended numbers and frequency of distribution to obtain a significant sample.
- To optimise the response rate, make sure that res-

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pondents are comfortable and available. Choose an appropriate time and place for the distribution (avoid polling a boater during a mooring manoeuvre, or a hiker during a walk).

Testing the questionnaire :

It is crucial to test the questionnaire on a small number of users (10 to 20 people) to check that respondents understand the questions and that the survey is not too long.

Processing and interpretation :

- Be cautious when interpreting the results obtained and avoid all generalisations, particularly if the sample representativeness is not known with certainty or if confidence intervals cannot be calculated.
- Allow for margins of error when interpreting the results (+/- 10% for 250 questionnaires, +/- 4% for 500 questionnaires).

5.7.7 Example of a management measure

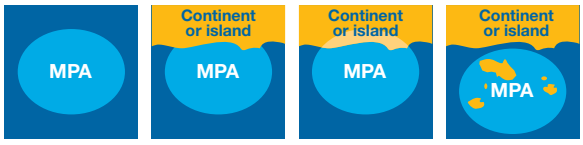
Monitoring indicators implemented by user surveys provide more information about the characteristics of user groups in the MPA and their activities, perceptions and satisfaction. In Port-Cros, this information has been used as a basis to develop a more effective communication strategy and the related tools, tailored to the range of user groups. A guide has thus been created for cyclists to better meet their expectations and improve their awareness of the vulnerability of natural environments. The survey results also showed that users are not sufficiently informed of water management on islands and fire risks. A stronger awareness effort was thus made on these aspects by Port-Cros National Park.

5.8 Regulatory Compliance Indicator

5.8.1 Relevance

This indicator measures user behaviour in relation to the rules and regulations in force in the MPA. It concerns the various user groups (boaters, sea transport passengers, divers, etc.), whether visitors or locals. The results of this indicator are closely linked to those of the indicator on User knowledge and perception of regulations.

5.8.2 Relevant MPA types



5.8.3 Framework protocol

Data collected : Number, type and location of offences recorded by the regulatory authorities, number of patrols and number of employees assigned to this activity.

Collection method : Collection of offence records completed during patrols and information rounds, or contact with the relevant authorities where applicable.

Location : MPA areas subject to regulations.

Frequency : Collection of records once a year, data collection on an ongoing basis, during patrols (variable frequency depending on the relevant enforcement structures and the MPA).

Time and cost : They depend on the time required for data collection which is relatively limited, and particularly on the time it takes to capture data for archiving which depends on the form of offence records (paper or electronic format).

Archiving : Excel©-type spreadsheet; use explicit coding for each type of offence.

Notice board explaining regulations in Zakynthos National Park (Greece)
© Credit: Catherine Piante

5.8.4 Advice

The number of patrols, the patrol routes and the number of employees assigned to the task directly influence the number and type of offences detected.

To compare results year over year, or from one season to the next, the number of offences must be weighted

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according to the control effort made as shown below:

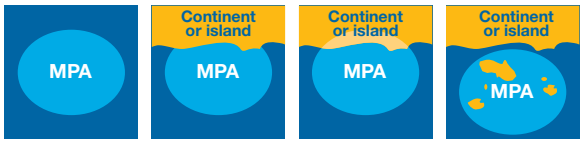
Regulatory compliance indicator = Number of offences recorded / (Number of patrols done * Number of surveillance employees).

5.9 Emerging activities and practices indicator

5.9.1 Relevance

This indicator aims to monitor changes in practices and activities carried out in the MPA to measure the impacts of new activities (canoeing, kite-surfing, whale-watching, stand-up paddling, etc.) or new practices (long-term mooring, naturism, high-speed water sports, etc.) as soon as possible.

5.9.2 Relevant MPA types



5.9.3 Framework protocol

Data collected : Number, type and location of new activities or practices observed in the MPA.

Collection method : Observation and recording of new activities or practices on datasheets or a book of emerging practices, filled in during patrols and information rounds.

Location : The entire MPA.

Frequency : Ongoing data collection, during the patrols (variable frequency depending on the management entities).

Time and cost : Short collection time, combined with patrols. The time it takes to capture and archive data will vary with the extent of any new practices or activities observed; however, one half-day of work per year should be sufficient.

Archiving : Use an Excel©-type spreadsheet with a simple structure to keep data entry time to a minimum.

5.9.4 Advice

The quantification and identification of new practices or activities in the MPA will greatly depend on the surveillance effort made. The number of patrols, the patrol routes and the number of employees assigned to patrols will determine the degree to which activities are recorded.

When a new identified practice or activity becomes significant (in space, time or number) or creates issues for the managers, it should be studied based on the same criteria and indicators as the "regular" uses. These new uses will then be integrated into the typologies used for counts done on land and/or at sea and user profiles, practices and perceptions will be obtained using the survey methods.

5.10 Weather and sea conditions indicator

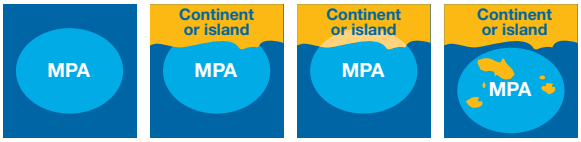
5.10.1 Relevance

This indicator provides quantitative data about daily, seasonal and annual weather conditions, i.e. wind force and direction, cloud cover and rainfall, temperature, and state of the sea.

Monitoring this indicator provides explanations of sudden changes in visitor numbers and use. Weather conditions directly impact :

- the decision to travel to the MPA by sea,
- the mooring area chosen by boaters and the search for a sheltered beach for swimmers,
- the choice of leisure activities carried out.

5.10.2 Relevant MPA types



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5.10.3 Framework protocol

Data collected : Weather and sea records to determine the representative conditions of the day.

Collection method : If possible, use a weather station that automatically records the climate conditions, or obtain the data from a competent organisation.

If neither of these two options is possible, records can be drawn up by observation, once a day early in the afternoon and always from the same site. At least a thermometer and a wind gauge will be necessary. Record the data on a structured field datasheet.

Alternatively, weather forecasts for the nearest surfing site can be downloaded from the website: www.windguru.cz Check that the weather model is appropriate first by comparing forecasts with observations in the field.

Frequency : Daily if possible. If not, a representative sample of monthly weather conditions of at least 15 days a month will be necessary.

Time and cost : One half-day of work to collect and archive the automatic weather recordings. Allow fifteen to thirty minutes a day for manual recording. A fee is often charged for data obtained from national weather organisations. Small equipment can be purchased at low cost (around €50 for a thermometer or a wind gauge), while a real weather station will cost between €500 and €1,000.

Archiving : If the amount of data is relatively small, and it is already aggregated by month or year, use a simple Excel©-type spreadsheet. If data is recorded on a daily basis, a database will need to be created using appropriate software.

Variables	Recording by observation	Automatic recording or collection of existing data
Wind force	Beaufort scale	In knots or km/h
Wind direction	Direction	Direction
Cloud cover	☐ Clear sky	As a %
	☐ Cloudy spells	
	☐ Overcast sky	
	☐ Mist	
Rainfall	☐ Drizzle	In mm/day
	☐ Odd showers	
	☐ Frequent showers or downpour	
Temperature	In °C	In °C
Condition of the sea	☐ Calm	☐ Calm
	☐ Moderate	☐ Moderate
	☐ Rough	☐ Rough
	☐ Very Rough	☐ Very Rough

Table 5 : List of variables needed to characterize weather and sea conditions

5.10.4 Advice

To report the data in a form directly linked to use monitoring, a typology of weather conditions is needed to analyse this indicator. At least three types of days should be identified :

- fine weather days : very good for visiting, these days offer optimal weather conditions for a massive influx of users;
- bad weather days : not at all good for visiting, the weather or sea conditions are a factor that greatly limit visitor numbers;
- moderate weather days : conducive to moderate visitor use.

The definition criteria of these days are specific to each MPA and vary with the activities considered. For example, a strong breeze can be good for sailing but will put swimmers off.

5.10.5 Example of a management measure

Weather conditions can considerably influence visitor activities in the MPA. Good understanding of these

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conditions will allow tourist behaviour to be analysed in detail. In turn, a better response (or not) can be provided based on the needs of certain users and the management objectives set. For deep-sea diving for example, the manager may decide to equip several sheltered mooring sites so that clubs can go out diving regardless of the direction of the wind. By characterizing practices based on site weather conditions, managers may also be able to anticipate any user conflicts (between swimmers and kite-surfers for instance) by planning activities in space and time.

5.11 Land-based accommodation capacity

5.11.1 Relevance

This indicator evaluates the capacity to accommodate visitors in tourist facilities on land (hotels, guest houses, camp sites, holiday villages, seasonal lettings). Monitoring this indicator reveals :

- potential tourist numbers in the MPA;
- development of the touristic function in connection with accommodation;
- the reorganisation of building functions in response to tourist demand.

This accommodation capacity represents the available supply of accommodation. The indicator can be honed with monthly or annual tourist accommodation occupancy data. Occupancy rate monitoring can be correlated with quantitative indicators of MPA use.

5.11.2 Relevant MPA types

5.11.3 Framework protocol

Data collected : Number of beds available to tourists within the MPA or in the adjoining tourist area (boundaries to be clearly defined in advance).

Collection method : Collect information from competent tourist organisations, by telephone or in writing. These entities differ with the country and may be local, regional or national.

Frequency : Every five years.

Time and cost : The time needed to collect data greatly depends on the willingness and/or ability of the organisations to provide information. The time may also vary depending on the country.

Archiving : Excel©-type spreadsheet.

5.11.4 Advice

To harmonise the results in the form of a number of beds, standardised multiplicative factors can be applied. They are no doubt specific to each country. In France, the national statistics institute (INSEE) considers that one hotel room corresponds to two beds, and that a holiday letting corresponds to five beds.

Depending on the country and available sources of statistics, it may be interesting to include non-market accommodation (capacity of holiday homes, at friends and relatives' homes, etc.).

5.11.5 Example of a management measure

It is interesting to correlate information about the land-based accommodation capacity and its variations with MPA visitor figures. Good knowledge of tourist accommodation places also helps improve information dissemination and awareness-raising action.

5.12 Capacity at sea indicator

5.12.1 Relevance

This indicator is designed to provide the number of spaces available for pleasure boaters in the MPA's organised mooring sites and harbours or in the sailing area (to be precisely defined at the outset).

Monitoring this indicator reveals :

- potential boat use in the MPA;
- the impairment of the maritime domain by development of mooring facilities;
- variations in boaters' behaviour towards secure mooring practices;
- boat use management directions chosen by the MPA manager.

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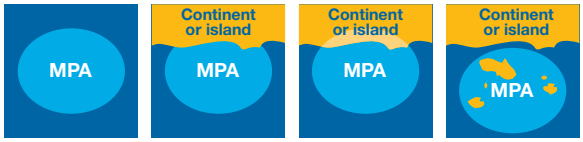
5.12.2 Relevant MPA types



5.12.3 Framework protocol

Data collected : Number and type of spaces available in facilities at sea (pontoons, buoys, wharfs) and in dry ports.

Collection method : Request for information by phoning or writing to the managers of harbour or mooring facilities (local authorities, private firms, user associations, etc.).

Frequency : Every five years.

Time and cost : One half-day of work to collect and archive the data.

Archiving : Excel©-type spreadsheet.

5.12.4 Advice

This indicator is designed solely to assess the accommodation capacity of organised mooring facilities. These facilities are used by pleasure boaters attached to a harbour space, on stopovers, and in search of secure mooring and the convenience and activity found in a harbour. The capacity of anchorage sites may be estimated using specific counts of boat numbers (by overflight or from a boat or a viewpoint).

The accommodation capacity is based solely on one physical criterion (number of people or boats that a facility can accommodate). It is therefore relatively easy to measure. Carrying capacity, however, is more integrated and complex and includes the concept of a critical threshold based on numerous criteria (physical, environmental, sociological, economic, etc.).

5.12.5 Example of a management measure

Like the land-based accommodation capacity indicator, it is interesting to correlate data relative to the capacity at sea and its variations with MPA boat figures. This indicator is also a tool for managing berths (at a pontoon or in mooring areas). When the number of berths is restricted, a specific pricing policy can be introduced to encourage the rotation of boats staying in the MPA. In Port-Cros for example, the cost of an overnight stay increases with the length of time spent mooring. This measure restricts the number of “parked boats” in the MPA.

5.13 Rental vehicle fleet indicator

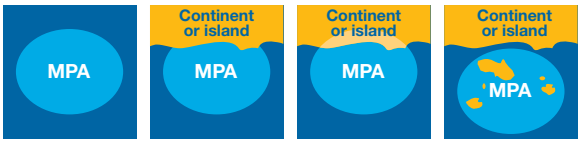
5.13.1 Relevance

This indicator provides an evaluation of the rental fleet of transport means available in the MPA. The rental entities may be based in the MPA or on the nearby coast, in a perimeter that must be clearly defined in advance based on the types of vehicles considered. Some examples include :

- at sea : inflatable dinghies, jet-skis, yachts, etc.;
- on land : bikes, scooters, cars, etc.

This indicator also reflects the extent of economic activity directly generated by tourism in the MPA.

5.13.2 Relevant MPA types



5.13.3 Framework protocol

Data collected : Number and type of vehicles available for hire and number of vehicle rental entities.

Collection method : Request information from the rental entities. If they are relatively small in number (less than twenty), it is a preferable to visit them. Direct contact fosters communication and the possibility of involving them in reflection on visitor management or even in the administration of questionnaires.

Frequency : Every year, at the start of the season.

Time and cost : Within the framework of monitoring, when relations are already well established with rental firms, it should only take about one hour per entity to collect data by direct contact and archive it. If information is requested by letter or phone, one day of work should be sufficient to gather and archive all the data.

Archiving : Excel©-type spreadsheet.

5.13.4 Advice

Cooperation with the rental entities is necessary to monitor this indicator. It depends on the relations that the MPA management entity has with those rental companies, and how sensitive they are to the MPA visitor management policy.

The data obtained is liable to be incomplete and extrapolation may be necessary to estimate the total fleet of rental vehicles in the MPA.

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5.14 Emergency response indicator

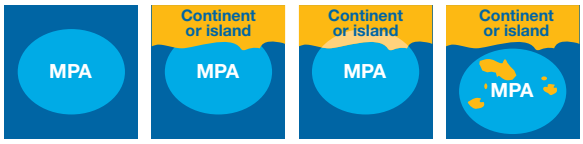
5.14.1 Relevance

This indicator provides an evaluation of visitor safety in the MPA by measuring the number of major emergency responses for casualties. This means emergency evacuation to hospital, by helicopter for instance.

This indicator also reports on needs for emergency aid based on the degree of visitor use and the type of activities carried out in the MPA. Monitoring the number of responses can provide baseline information for adjusting the level of emergency means.

Lastly, it reveals the extent of emergency situations and stress that the management team must cope with in the field.

5.14.2 Relevant MPA types



5.14.3 Framework protocol

Data collected : Number of emergency responses described as major. A typology of emergency response operations will need to be defined beforehand.

Collection method : Collection of emergency response records from entities responsible for assisting casualties in the MPA (fire brigade, rescuers at sea, etc.).

Frequency : Collection of records once a year, ongoing data collection.

Time and cost : Emergency response records are generally part of the work done by emergency rescue workers. Allow one half-day for collecting, entering and archiving the data obtained.

Archiving : Excel©-type spreadsheet.

Life guard station at Cerbère Banyuls Nature Reserve (France).
© Credit: Réserve naturelle de Cerbère Banyuls.

5.14.4 Example of a management measure

The emergency response indicator is particularly useful to improve MPA user safety and adapt management to tourist activities. On Porquerolles Island, the implementation of this indicator correlated with the road and path use indicator highlighted the significant number of accidents involving cyclists. This led the Town Council to prohibit cycling on the island's dangerous routes (remote pathways), a measure which also indirectly improved protection of the avifauna.

5.15 Cross-disciplinary indicators

These indicators ultimately aim to identify and measure the impacts of visitor use. They require the manager to commit to a long-term programme, with the assistance of scientific experts in various disciplines. This kind of study is particularly complex to do. However, series of data obtained with simple protocols can enlighten managers and provide an initial basis for work by researchers.

5.15.1 Relevance of Visitor use/ environment interaction indicators

This kind of indicator is designed to assess the impact of visitor use on the MPA's vulnerable habitats and species. This is a central topic in terms of managing biodiversity.

This indicator requires knowledge of the pressure that visitors generate for the habitat or species studied, both in terms of extent and behaviour. It further aims to provide knowledge of the environmental status of the habitats or species subjected to this pressure from visitors. Combining the social science and environmental perspectives of the two approaches can involve some considerable difficulties, including :

- adopting appropriate spatial and time scales for the study;
- developing common terminology and cross-disciplinary methods;
- the length of the study, which must be long-term to assess how environments react to visitor pressure;
- indentifying and factoring in several sources of impact other than visitor use.

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5.15.2 Relevance of the Economic benefits of visitor use indicator

This indicator requires the development of a socio-economic study and aims to answer two key questions :

- What are the economic benefits of visitor use (in terms of employment and added value) of the MPA for economic activity in neighbouring areas.
- To what extent can visitor use generate revenues to fund the cost of MPA protection?

The scope of monitoring this indicator extends greatly beyond the boundaries of the MPA. In the same way as the issue of conservation, inclusion of this economic dimension is vital for the definition of sustainable tourism in the MPA.

Multidisciplinary indicator implementation in Les Calanques National Park (France).

The Liteau FHUVEL programme (Fréquentation Humaine et Vulnérabilité Écologique du Littoral - Visitor use and Environmental vulnerability of the Coast) for the 2009-2012 period primarily aims to develop a cross-disciplinary methodology to assess the vulnerability of the remarkable coastal ecosystems (coralline, Posidonia grass beds and Trichoptera) and to identify the factors responsible for that vulnerability to prioritise conservation or even restoration needs. By crossing indicators, FHUVEL interlinks biological data with visitor and use data to identify sociological and ecological tolerance thresholds and move towards carrying capacity indicators.

The workshop sites are expected to provide concrete contributions to help develop management and decision tools for use in Les Calanques National Park, taking account of uses, social representations and the necessary protection of nature.

Coralline formation, Les Calanques National Park (France).
© Credit: Olivier Bianchimani

The benefit of an initial evaluation of visitor use and biocenoses to assess the impact of a new development: the example of the Tables diving site in the Posidonia grass beds of Cap d'Agde marine protected area (France).

The Tables site is a small, rocky submarine area only a few hundred metres from the cliffs of Cap d'Agde. It consists of a set of volcanic tuff slabs with numerous faults, caves and overhangs that are home to extremely diverse fauna and flora greatly sought-after by divers.

At the Tables site, the problem of visitor use (diving and mooring) and its impact was addressed relatively early on. Studies were initiated in 1999 (Musard, 1999; Payrot, 2001) and evidenced the significant pressure generated by deep-sea diving on certain coastal sites of Agde including the Tables, with numbers in summer estimated at 8,500 dives and some 850 mooring boats. Surveys were also conducted with local diving clubs and the opinions obtained were unanimous about the problem of "overcrowding" in the Tables site. Plans were therefore made in 2005 to install seven Harmony-type ecological mooring buoys at the site, following an initial analysis to be able to subsequently monitor and measure the effects of the new facilities on marine biocenosis restoration. The white gorgonian seafan *Eunicella singularis* was selected as the indicator species owing to its representativeness in the study zone and because it is a sessile organism which, by definition, cannot flea pressure.

The study was conducted in 2010 and 2012 by the Association ADENA. After only five years, the restoration of the white seafan population was already taking place at the Tables site. Analyses showed a clear growth in the population between 2005 and 2010 which continued until 2012, together with development in the coverage of rocky areas. The high densities of young gorgonians reflect the area's potential for development and regeneration. With an increase in densities of large gorgonians too, the results concerning the natural restoration of white seafan are extremely positive, both in terms of the conservation benefits of this kind of mooring and the willingness of diving clubs, as stakeholders of the "Posidonies du Cap d'Agde" Natura 2000 site, to use the facilities for sustainable protection.

Reference : Blouet S., Chéré E., Dupuy de la Grandrive R., Foulquié M. 2010. *Restauration naturelle des populations de gorgones blanches Eunicella singularis (Esper, 1794) après installation d'ancrages écologiques Harmony, sur le site de plongée des Tables. "Posidonies du Cap d'Agde" Natura 2000 Site FR-9101414.* ADENA publ. Fr. : 58PP.

Foulquié M., Blouet S., Chéré E., Dupuy de la Grandrive R., Fabre E., Dalias N., 2012. *Restauration naturelle des populations de gorgones blanches Eunicella singularis (Esper, 1794) après installation d'ancrages écologiques Harmony, sur le site de plongée des Tables. "Posidonies du Cap d'Agde" Natura 2000 Site FR-9101414.* ADENA, SEANEO publ. Fr. : 91PP

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6. Implementing indicators

Once the indicators have been selected and the protocols tailored to your MPA, their implementation must be organised. Certain difficulties can then arise: the need to alter protocols during the study, varying data quality year over year, difficulties making comparisons, loss of information, lack of coordination, lack of observatory ownership by the management team, dilution of responsibilities, etc.
A few simple guidelines can help restrict these implementation difficulties.

6.1 Preparing and harmonising field data report forms

Certain data collection materials need to be prepared and specifically adapted to the features of the MPA and the aim of the study. This is particularly the case with :

- count report forms (passenger arrivals, boats in mooring sites, flows of cyclists on paths, etc.);
- field data records (records of offences, weather conditions, etc.);
- survey questionnaires (multiple-choice or interviews).

The format of these collection tools should be harmonised (same counting typologies, same organisation of multiple-choice questions, etc.), to facilitate their use and subsequent data processing and archiving.

6.2 Installing and testing technical tools

Certain data collection means involve technologies of varying degrees of complexity, so it is important to test them prior to actual use.

- For overflights, the flight plan must be prepared with the pilot, all the flight authorisations must be obtained, the condition and range of the camera must be checked, and photo-interpretation limits must be assessed;
- Handheld counters should be rounded up and labelled, as they can quickly get lost;
- The installation plan for the network of automatic counters on paths must be defined, the equipment installed (acoustic slab sensor, pyro-electric sensor or magnetic loops) during a quiet period, and checks must be done to ensure the counters and recording equipment work correctly.

6.3 Testing protocols

It is advisable to test the data collection protocols in real situations. Their feasibility must be checked with the assurance that nothing will hinder the smooth conduct of surveys, that respondents understand the multiple-choice questions, that entities holding data are prepared to disclose it, that automatic counters work, etc. Counting protocols should ideally be tested during averagely busy periods and not during the low season.

6.4 Organising and standardising indicator implementation

To guarantee the sustainability of the study and data usability, protocols must be formally documented and a record should be kept of the conditions in which they are implemented each year. Managers should :

- draw up a clear, technical compendium of methods setting out the collection protocols for each indicator in detail to guarantee reproducibility;
- define a schedule of monitoring operations each year.

6.5 Forming a team

Forming a team motivated by the issues of visitor use and responsible for implementing the indicators in the MPA is a key factor in the success of the study. It is therefore advisable to :

- Assign MPA employees to the study and provide each team member with training. The team should be involved in the visitor use monitoring project right from the start. They can make valuable contributions in various areas due to their in-depth knowledge of the field. The protocol tests are an excellent opportunity for training using the compendium of methods as learning material.
- Keep involvement of trainees to a minimum as this can demand a considerable training effort and restrict the study in terms of knowledge of the MPA and communication with users; it can also have a disincentive effect on the team managing the study.
- Appoint a lead coordinator to oversee the entire study (indicator definition and adjustment, verification of collected data, schedule preparation, participation in data reporting). Different people may be put in charge of certain aspects (counts, data capture, etc.), but their respective tasks shall not replace the lead coordinator's role.

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7. Archiving and processing data

Storing, processing and interpreting data are major steps in the study. The aim is to create a record of visitor uses and produce results that are useful for management purposes. Thought should be given to the organisation and analysis of data before it is collected, to avoid problems such as split data, different data formats, and difficulties correlating information.

7.1 Creating a database

A database allows the information necessary for the study or monitoring to be centralised and archived for later use.

The time required to create a database should not be underestimated. This step should be planned, or even completed, before you begin collecting data. It is a crucial step in the production of visitor use monitoring results.

Several computer media can be used, depending on the data entry and processing objectives. However, it is important to opt for a simple system that is within the reach of the monitoring team. A few examples will help guide managers in their choice :

- A database consisting of Microsoft Excel-type spreadsheets is recommended as they are easy to use. However, careful organisation is necessary when handling several files to avoid information being scattered between several computers. Spreadsheets can only contain a limited number of data and are appropriate for specific, short-term studies. Macros can be used to facilitate data capture but this remains a tedious task and must be carefully guided (by a manual of typology codes for example) and regularly checked.
- Geospatial databases in a Geographic Information System (GIS) make spatial information analyses possible, particularly counts. They demand extensive structuring work and sound user training. They should only be used to achieve elaborate processing and mapping goals.
- With Microsoft Access or Open Source database management systems (DBMS), a large amount of data can be organised and stored in a single tool. They are particularly appropriate for long-term monitoring. However, special computer skills are required to structure and update them. As a database user, the manager may use a service provider to carry out these tasks, but this means that clear specifications must first be drafted. The specifications may include the creation of simplified and secure capture interfaces, and programmes to automate the main computing processes.

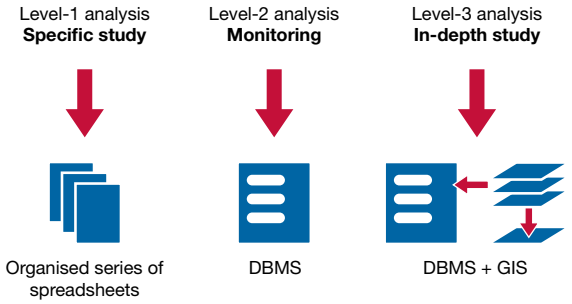

Figure 13 : Choice of database based on analysis goals

7.2 Recommendations for database use

- Appoint a database manager who will report any difficulties to the study coordinator.
- If the database is used internally, access to it may be unrestricted. However, in the event of any external use or involvement of trainees, access to the database should be secured with codes for example, to avoid all alteration to the source data.
- Store source information in the database, not interpreted or analysed data. Bear in mind that an interpretation is only relevant for a certain amount of time and can eventually become meaningless.
- Do the processing without altering the source data.
- Opt for the easiest processing operations possible, close to the field data. Avoid overly complex interpretations and correlations which render the results difficult to understand.

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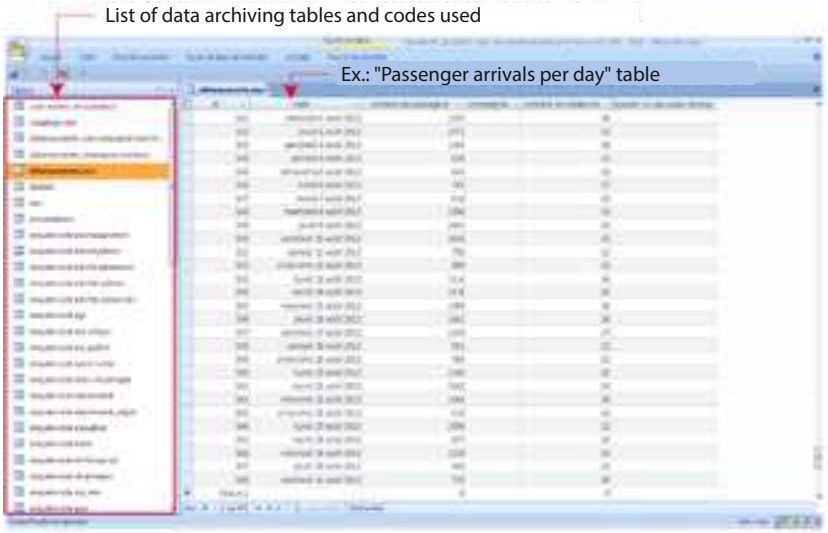
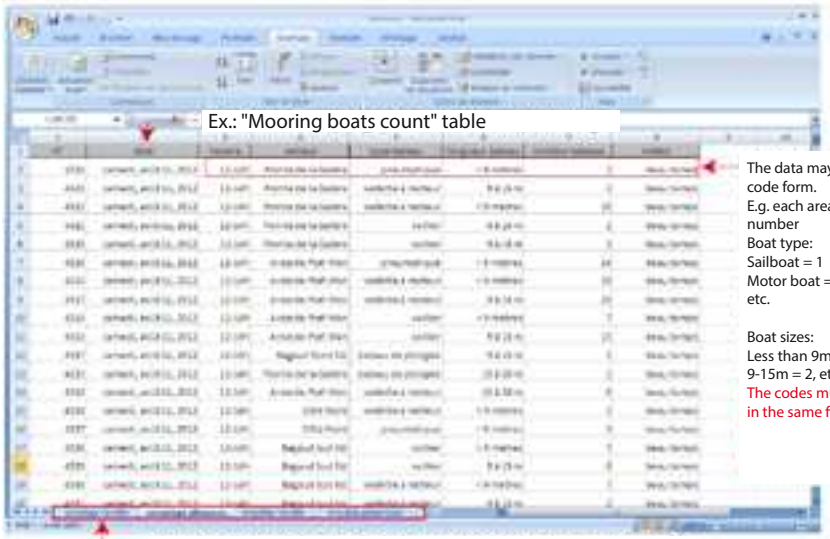


Example of archiving in a database management system (Microsoft® Office Access) : "Passenger arrivals per day" table



Example of archiving in a spreadsheet (Microsoft® Office Excel) : "Mooring boats count" table

Figure 14 : Examples of archiving.

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8. Reporting and sharing results

Reporting the results of the visitor use study or monitoring is of major importance for shared MPA management processes. Efforts should be made in terms of communication to adapt the disclosure to the various stakeholders likely to consult and use the results.

8.1 Guidelines for preparing reporting media

At the end of any study, it is vital to draft a report presenting the aims of the study, the methods and protocols used and the results of the collected data analysis. However, this kind of document is often an ineffective means of communication and should be kept for internal use. To share the results more broadly, summary documents should be drafted in the form of datasheets. A few guiding principles will guarantee their readability :

- Prepare one to four thematic datasheets, roughly summing up the main results of the study. For a monitoring project, these datasheets can be prepared each year.
- Include methodological information (number of questionnaires handed out, boat count protocol, etc.). Providing information about the collection method makes the results easier to understand.
- Avoid complex interpretations that are difficult to understand and report. Stay close to the field data.
- Present the datasheets carefully as they are intended for a wide audience. Avoid using overly technical terms and include photographs and maps, where possible, for better viewing of spatial information.

8.2 Disclosing results

The full study report and the datasheets can be posted online on the management entity's website. The results can be integrated into the MPA's newsletter.

One excellent way of disclosing results is by organising a public presentation. Such a meeting is an opportunity to talk with local stakeholders (inhabitants, professionals, local authorities, user associations, etc.) and lay the foundations for collective reflection. It is also an opportunity to call for partners, and allow certain stakeholders to join in a future study or subsequent monitoring.

Local stakeholders may feel excluded if communication about the study carried out by the MPA manager is insufficient. This can lead to them contesting the results. To foster dialogue, it is a good idea to organise a public meeting at the start of the study to present the objectives and methods. This information meeting contributes to local stakeholder acceptance of and support for the study. Others should be held as the project progresses. This is how the MPA will become a territory shared by various players.

8.3 Examples of result reporting sheets

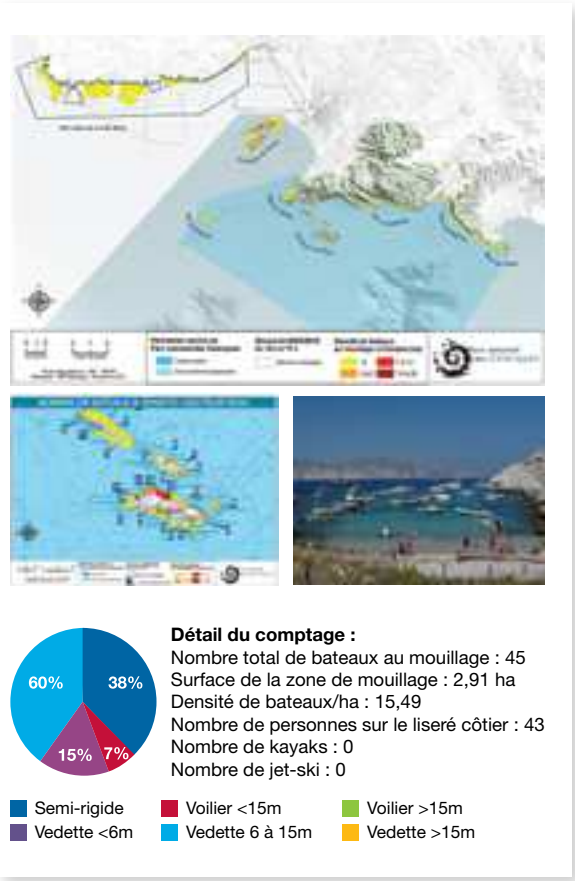

Figure 15 : Example of a data report on visitor use in the Riou area, Les Calanques National Park (France).

8.4 A first step towards implementing visitor management measures

Regular visitor use monitoring provides a sound and reliable record of visitor use. In addition to this obvious advantage, it is also the cornerstone of a variety of management measures. Quantitative data can be organised so as to determine visitor thresholds and beyond that, to engage reflection on the complex but important issue of carrying capacity. With this objective in sight, certain carrying capacity indicators have been directly developed by the area manager of Port-Cros National Park. Similarly, qualitative data is extremely valuable when assessing visitor satisfaction with what they have seen and done during a trip or a holiday. It can also provide long-term guidance for managers' accommodation and

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development policies for example. This guide only touches on the matter of management measures but a supplementary guide focusing primarily on this aspect could subsequently be developed based on different individual experiences.

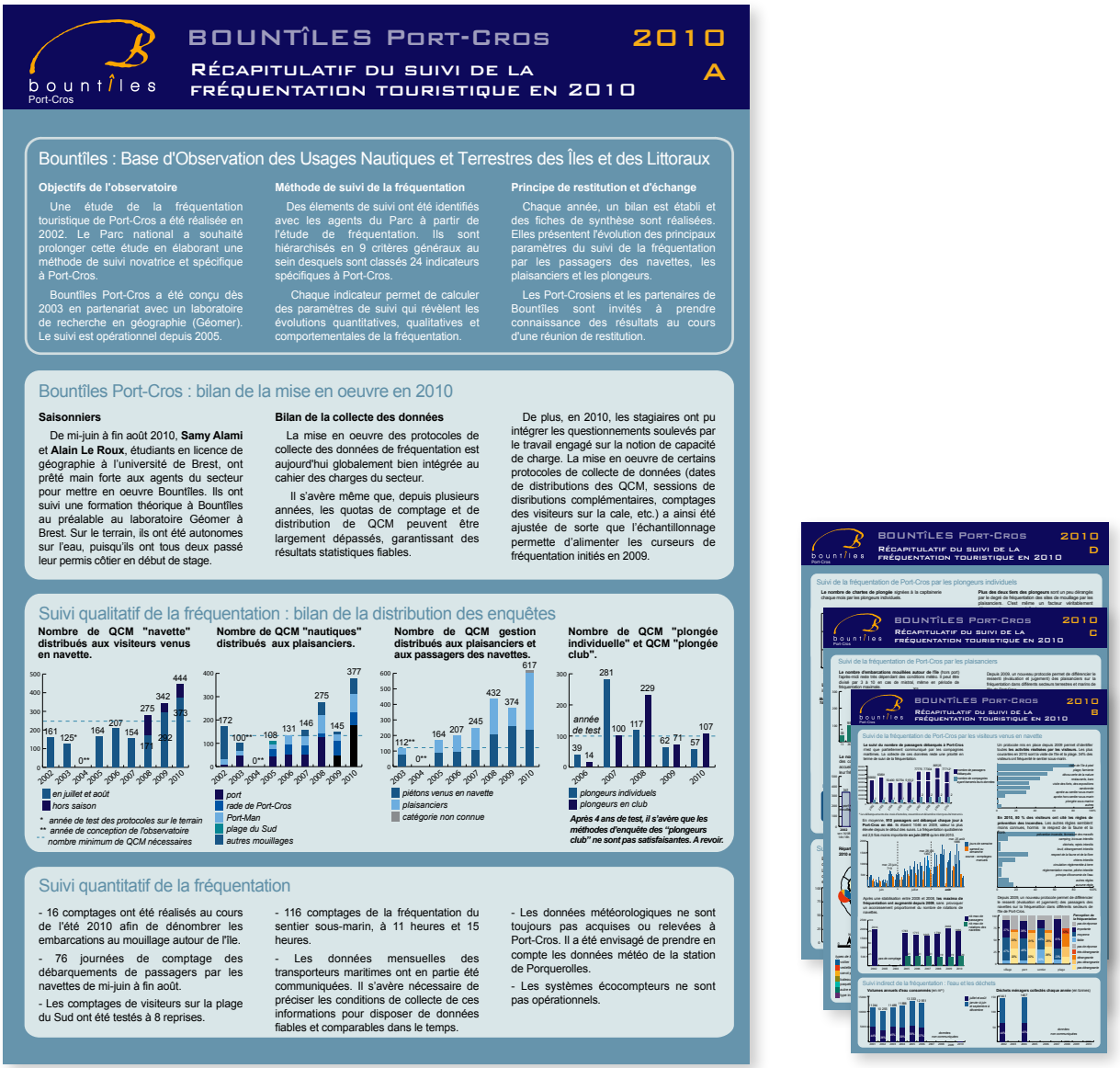

Figure 16 : Four annual data reports, A. Methods B. Visitor uses on land C. Nautical tourism uses at sea D: Scuba divers

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9. Conclusion

To complete this document, a few essential points should be mentioned concerning the current context of recreational activity monitoring in marine protected areas and the limits inherent in this kind of exercise. Lastly, certain future prospects which could eventually enhance and complete this initial work will be explored.

9.1 Integrating tourist uses into monitoring

The development of water-based recreational activities, together with renewed interest in marine areas, explains the growing popularity of marine protected areas. Today, the managers of these areas of great environmental value must take these new uses into account to restrict their impacts while allowing the greatest number of people to have access to the sea, the coast and the islands that are within the MPA.

For a long time, researchers focused specifically on animal species, then plant species and lastly habitats. However, the first research factoring in the visitor aspect and placing it at the centre of studies is relatively recent. In this area, Port-Cros National Park has played a pioneering role by initiating visitor use monitoring studies in its territory in 1988. Later, it was also the first to create a veritable visitor observatory, which has now been in operation for ten years.

These actions have been extended by the organisation of several seminars on the theme, one of which was attended by a number of Mediterranean MPA managers. This guide is the joint result of talks held at one of these meetings on tourist monitoring in marine protected areas as part of the MedPAN Nord project in June 2011, plus lessons learned from the experience of Port-Cros National Park through the Bountîles observatory.

9.2 Limits

This guide does not therefore purport to embrace the entire subject. It is based both on experience gained in the field by marine area managers and that of several teams of researchers in human and social sciences working on visitor use themes.

There lies the originality of this document, but also one of its limits. So that this guide is easy to read and can be used rationally and pragmatically, only selected, streamlined topics could be addressed. Users of the guide, i.e. mainly managers, should therefore use it as a methodological framework based on which they will tailor the suggested methods to their own area.

Furthermore, as it relies greatly on scientific research and monitoring done on Port-Cros and Porquerolles Islands, it makes extensive use of lessons learned from the studies done on the islands' land parts and coastlines. It would no doubt be appropriate, like the current projects carried out in the Channel and the Atlantic on other marine protected areas, to address issues more specifically relating to strictly marine areas.

Progress will indeed be made in this area by encouraging new applied research into recreational activities in marine areas and by developing partnerships between managers and scientific experts.

9.3 Prospects

Marine protected areas are relatively recent as is experience gained in visitor use monitoring. This guide is therefore naturally only a first building block in work on a very vast subject, the contours of which evolve in a changing socio-economic context and with the development of nature tourism. We hope that this first initiative will provide certain answers to the many questions raised by managers.

Feedback that could be provided after implementing some of the indicators proposed in the guide will be vital. It will eventually help to improve and enhance this guide. From this perspective, and to further knowledge in this area, we strongly encourage users of this guide to share their remarks, suggestions and ideas for new indicators with us.

Another seminar could ultimately be planned to hold a review and to advance in research into monitoring methodologies and tools.

By developing a collective, shared approach, new ideas useful for managing tourism in Mediterranean marine protected areas will emerge.

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Appendices 1 - Visitor data collection method summaries

The summary of visitor use study methods presented here is taken from: Le Corre, N., Le Berre, S., Meunier, Brigand, L., M., Boncoeur, J., Alban, F., 2011 - Dispositifs de suivi de la fréquentation des espaces marins, littoraux et insulaires et de ses retombées socioéconomiques : état de l'art. Rapport Géomer LETG, UMR 6554 et UMR M101 Amure, Université de Bretagne Occidentale, Agence des Aires Marines Protégées, 150p.
Only the methods written in bold have been detailed in this guide as they have been implemented and validated in the Port-Cros and Porquerolles sites (Port-Cros National Park) as part of the Bountîles observatory. The other collection methods are identified in academic or scientific papers but they are more complex to implement, mostly relate to in-depth visitor monitoring and require specific external skills (scientists, specialised research offices, etc.).

1. Methods aiming to quantify visitors in coastal land areas

The quantitative approach, which provides figures, reveals the intensity of visitor numbers in land and island areas. It indicates the distribution, but can also provide qualitative information about uses in certain cases. Quantitative data collection methods are mostly based on counts. There are many different methods that have often been validated and successful. Although coastal areas and islands have a certain number of specific features, the visitor counts that can be done in them benefit from extensive scientific research carried out on other land-based nature sites.

There are two types of counts :

- Direct counts, reflecting realities in the field.

Some of these counts provide static facts, which offer a vision of visitor numbers at a given time T :
  - **Manual counts done by staff over the whole site,**
  - **Overflights with photographing,**
  - Satellite image processing,
  - Use of mobile telephone data.

Others provide dynamic data, such as "visitor flows" :
  - **Sea transport company data processing,**
  - **Manual visitor counts upon disembarkation on islands,**
  - **Automatic counts using magnetic loops, infrared sensors, motion sensors, seismic detectors, optical sensors, microwave sensors,**
  - Counts using automatic photographs or video cameras.

- Indirect counts, revealing trends, orders of magnitude, or a relative assessment of visitor numbers.

Visitor assessment by presence indices based on :
  - **Processing of official data produced by managers,**
  - **Processing of sea passenger tax data ("Barnier tax" in France),**
  - **Processing of data about permits, licences or charters for a professional, recreational or tourist activity,**
  - Surveys by mail, email or the internet,
  - Quantifying visitors by artificial intelligence (developed solely on Conservatoire du Littoral sites in France),
  - Variation in flour consumption method, voluntary registration on protected area registers.

2. Methods aiming to quantify visitors in marine areas

Like land areas, figures obtained with the quantitative approach are vital to understanding visitor use of marine areas. However, implementing counting methods at sea involves several difficulties, as the spaces are vast and open or geographically complex like archipelagos. Many methods are still experimental today.

Like land areas, there are two types of marine area visitor counts :

- Direct counts, reflecting realities in the field.

Some of these counts provide static facts, which offer a vision of visitor numbers at a given time T :
  - **Manual counts of water-based activities or mooring boats,**
  - **Overflights with photography of water-based activities or coastal and island mooring sites,**
  - Overflights with location of vessels at sea by GPS,
  - Overflight with onboard camera,
  - Satellite image processing.

Others provide dynamic data, such as "visitor flows" :
  - Manual counts of boat flows on launches,
  - Manual counts of boat flows at the exit from marinas,
  - Processing of data from semaphores and other maritime surveillance entities,
  - Processing of AIS (Automatic Identification System) data,
  - Automatic counts using equipment such as infrared sensors, etc.,
  - Processing of Radar and Sonar data,
  - **Processing of data from sea transport companies or harbour facilities.**

- Indirect counts, revealing trends, orders of magnitude, or a relative assessment of visitor numbers :
  - **Processing of data about permits, licences or**

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charters for a professional, recreational or tourist activity,
› Surveys by mail, email or the internet.

3. Methods aiming to determine visitor characteristics in marine, coastal and island areas

While the quantitative aspect is vital, it would be pointless without conducting interviews and surveys to determine the characteristics of visitors, uses and practices. The questions asked and the themes addressed aim to discover the various user groups, their perception of the site, their expectations and their suggestions. Based on surveys, these methods come within the sphere of sociology and anthropology. Surveys must be developed, conducted and analysed according to strict scientific principles, and many operations carried out in protected coastal sites by non-specialised organisations involve significant sampling and interpretation bias.

There are two major categories of survey methods, depending on the scale selected :

- Small-scale surveys, used to address the question of visitor use with the population of a country, a region or a county.
  - › Tourist surveys,
  - › Surveys by mail, email or the internet.
- Full-scale surveys, used to address visitor use locally with a population of users of a protected area or a site.
  - › **Interviews (non-directive, semi directive, directive),**
  - › **Standardised questionnaires (with closed-ended and/or open-ended questions).**

4. Methods aiming to determine user behaviour on sites

The behavioural approach to uses is mainly based on participant or other observations, generally involving researcher immersion in the survey site. The diversity of users and their practices are extensively taken into account, thus providing keys to understanding visitor use phenomena that are vital to characterise visitor systems in detail. The behavioural approach is equally interesting in work done on protected site governance.

Ten methods relate to this behavioural approach :

- Ethnographic-type observations of the various groups of users, field books,
- **Maps from the ground,**
- GPS monitoring,
- Itinerary reconstruction (based on surveys),
- Use of mobile telephone data,
- Use of video,
- Processing of AIS (Automatic Identification System) data,
- Processing of data from black boxes on board ships,
- Processing of I-Tracker data.

Appendix 2 details the technical implementation of two quantitative data acquisition methods: automatic counter installation on land and overflight of marine areas with photographs.

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Appendices 2 - Technical datasheets

Technical datasheet – Automatic counter on a path or road

Objective : Durable data acquisition to quantify and describe visitor flows along a path in the MPA.

Points to examine prior to installing an automatic counter

Path width : the width of the path may determine the technology to be used and the equipment cost. It is often better to choose a narrow path, or to position the counter at a point where the path narrows.

Type of substratum : the type of substratum can restrict the choice of technology. Acoustic slab sensors cannot be installed in bedrock for example.

Path user groups : walkers, cyclists, two-wheel motor vehicles, etc. Based on the groups using the path, the manager will have to adapt the technology to be used.

Target user groups for the count : does the manager want to :

- Count total users?
- Only count one kind of use?
- Distinguish between different user types?

Direction detection : does the manager need to detect the direction of flows? This is not vital to assess total user numbers but it can be useful to find out about routes, particularly when the site is equipped with several counters.

Site layout restrictions : are/can fixtures be installed on site? Some counting systems need the sensor to be placed on a wooden post for example.

Site security : is the site secured for risks of human-induced or natural deterioration? The manager must assess the risk of vandalism on the site and make sure that equipment is not installed on a path subject to natural risks (flooding, marine submersion for example).

Examples of available technologies (non-exhaustive)

Infrared pyro-electric sensor, optical and radio sensors

Types of flows processed

Walkers, cyclists, horse riders

Advantages

- sensor counting several flow types (total use or different practices)
- relatively easy to install
- some models adapt to relatively wide paths (approx. 10m)

Drawbacks

- requires fixtures to fit the box (e.g. post)
- regular maintenance to check that nothing interferes with the signal (vegetation, insects, etc.)

Acoustic slab sensor sensitive to pressure variation

Types of flows processed

Walkers

Advantages

- robust
- invisible
- precise

Drawbacks

- cannot be used on a rocky substratum
- involves digging into the substratum
- heavy vehicles should not use or park on the path equipped with slab sensors (e.g. tractors)

Magnetic loops

Types of flows processed

Cyclists, cars

Advantages

- easy to implement if remains visible
- invisible installation possible
- precise

Drawbacks

- if buried, involves digging the substratum or asphalt
- operating range varies with the systems

Remark : whichever system is chosen, the manager should pay particular attention to the following aspects when choosing equipment: robustness, resistance to bad weather (tightness), battery range, maintenance conditions, data retrieval and processing conditions.

Example of installing acoustic slab sensors without flow direction detection (such as an Eco-counter)

www.eco-compteur.com/

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Technical datasheet - Overflight for manual photographing

Objective: Data acquisition to manually quantify and determine types of boats mooring or sailing in the MPA.

Remark : the method described below is entirely manual for the sake of easy implementation. High-tech automatic methods developed by specialized firms do, however, exist.

Overflight preparation

Is it possible to fly over the MPA : before considering an overflight of your MPA, make sure that no regulations prohibit or control (applying for authorisation) overflying the study zone (military or environmental regulation for example).

Choice of aircraft : irrespective of the kind of aircraft chosen, the operator must make sure that it offers good visibility for taking aerial photographs. ULMs or high-wing monoplanes should therefore be preferred.

Choice of photography equipment: a digital camera with a resolution of at least six million pixels allows boats to be identified during post-processing. The camera must also be responsive, i.e. with short trigger and waiting time between two photographs.

Flight plan : a flight plan must be prepared and approved by the pilot and the photographer before the flight. The flight plan must be adapted to the site and to the aim of the flight. The plan must also avoid photographs being taken into the light, allow an identifiable land part to be included in each wide-angle shot and avoid double counts.

Precautions for aerial photographs during the overflight

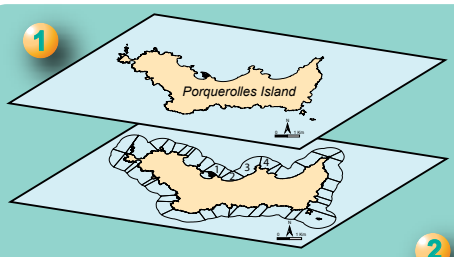
Flying speed and altitude : flying speed must be reduced and, depending on the aim of the flight, the aircraft will fly at approximately 1,000 feet for simple boat counting and locating or at 500 feet to determine the type of boats from the shots taken.

Taking shots : photographs can be used to quantify, characterise and spatialise boats in the MPA. Several hundred pictures can rapidly be taken during one overflight. The photographer must therefore bear in mind that a small number of pictures will facilitate manual post-processing.

Therefore, the photographer will opt for wide-angle shots including a land part in order to locate the photo. Boats will be identified by zooming in on them when analysing the image.

Manual photo processing and analysis: example of Porquerolles Island (France)

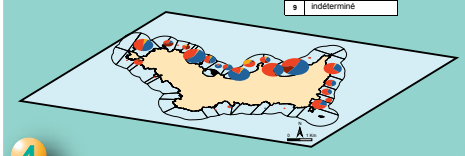
1



Delimitation and coding of the MPA's mooring or sailing areas. Boats can then be counted and identified by sector.

Creation of a typology of boats adapted to the characteristics of the fleet in the MPA.

Type d'embarcation		Longueur	
Code	Libellé	Code	Libellé
1	Vedette habitable	1	< 6m
2	Vedette non habitable	2	6 à 10m
3	Pneumatique	3	10 à 15m
4	Voilier habitable	4	15 à 20m
5	Voilier non habitable	5	>20m
6	Jet-ski		
7	Bateau de plongée		
8	...		
9	indéterminé		



4 *Mapping by mooring sector.*

2 *Counting, characterisation and location of boats using oblique aerial views.*

id	date	heure	type_comptage	code secteur	type bateau	longueur bateaux	nombre bateaux	météo
1	samedi, août 13, 2011	14h00	survol	251	vedette mot. habitable	15-20m	2	beau temps
2	samedi, août 13, 2011	14h00	survol	251	vedette mot. habitable	10-15m	2	beau temps
3	samedi, août 13, 2011	14h00	survol	251	vedette mot. habitable	moins 10m	5	beau temps
4	samedi, août 13, 2011	14h00	survol	251	voilier habitable	15-20m	2	beau temps
5	samedi, août 13, 2011	14h00	survol	251	pneumatique	moins 10m	2	beau temps
6	samedi, août 13, 2011	14h00	survol	251	voilier habitable	10-15m	1	beau temps
7	samedi, août 13, 2011	14h00	survol	261	voilier habitable	10-15m	4	beau temps
8	samedi, août 13, 2011	14h00	survol	261	vedette mot. habitable	10-15m	1	beau temps
9	samedi, août 13, 2011	14h00	survol	261	vedette moteur non habitable	moins 10m	1	beau temps

3 *Information archiving in a GIS or spreadsheet database.*

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The MedPAN collection is a series of publications designed to provide Marine Protected Areas (MPA) managers and other stakeholders in the Mediterranean, guidance, practical and useful information, experience feedback or overviews on key MPA management issues.

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