

# Participatory Monitoring Guide for Shellfish Collected in West Africa

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*'Exploiting is one thing,  
Conserving another;  
Choosing between the two,  
That's real management'*

*Dr Malick Diouf*

A joint initiative of



# **Participatory Monitoring Guide for Shellfish Collected in West Africa**

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# Introduction

In West Africa, shellfish are primarily collected by women, in mud flats and mangrove plantations at varying distances from the villages. Shellfish are a resource of major interest, as a source of animal proteins and income for coastal populations. Indeed, they have always been an important source of revenue for West African women. In the face of runaway demographics and family needs, pressure on this resource continues to grow. As a result, the sustainability of this activity is under threat from environmental, demographic and socioeconomic developments in certain areas. A considerable drop in the production of the different species has been observed, some of which have even become endangered. To safeguard the role played by shellfish, players in the sector and the authorities continue to pursue avenues and means for improving the sustainable management of this resource (preserving the resource and increasing the added value of processed products).

In 2009, the Fondation Internationale du Banc d'Arguin (FIBA) implemented a project entitled Management of West African Marine and Coastal Biodiversity through Support for Conservation and Monitoring Initiatives in Marine Protected Areas (BioCos) with the financial support of the French Global Environment Facility (FFEM). The specific goal of Component 2 of the BioCos project (BioCos C2) is to establish reliable systems for monitoring the ecological and socioeconomic impacts of Marine Protected Areas (MPAs), using simple, realistic and participatory methods wherever possible.

BioCos C2 seeks to measure the ecological and socioeconomic effects of the MPAs in order to raise players' awareness as to the benefits of an MPA (where proven) and to contribute to informed decisions on management measures to be implemented or adjusted. Shellfish collection was selected for monitoring from amongst the various ecological effects identified as measurement priorities for the project's pilot MPAs (Bamboung and Casamance in Senegal, Urok in Guinea-Bissau, Niuni in Gambia and Tristao-Alcatraz in Guinea).



# 1.Objectives, monitoring types and expected results

## Who is this guide for?

This guide was developed for anyone involved in monitoring and managing shellfish collection activities in West Africa, and particularly MPA management teams and local populations participating in data collection.

## What are the monitoring objectives?

The objectives of the shellfish monitoring programme are to:

- Evaluate the state of health and the replenishment capacities of shellfish populations (baseline);
- Measure the scale and impact of collection activities;
- Provide information to guide and support the institution of sustainable management measures; and
- Assess the impact of shellfish management measures on the MPA.

These objectives require finely tuned, scientifically validated, quantitative methods for monitoring shellfish, that will be feasible for local players working within a participatory framework and with limited resources. The methodology presented here is based in part on scientific work conducted in a variety of countries and in part on local empirical knowledge and techniques. In particular, it was inspired by and used to validate other work conducted under the MAVA-FIBA project, Women & Shellfish (2006-2008).

## What are the target species?

The main species targeted by the monitoring activities are those utilised by the local populations. They are listed below by order of importance :





1. Ark clams (*Senilia senilis* or *Arca senilis*);
2. Mangrove oysters (*Crassostrea gasar*);
3. Gastropods: melongena (*Melongena*), volutes (*Cymbium* spp.) and rock snails (*Murex* spp.); and
4. Razor clams (*Tagelus adansonii*).

*NB: Razor clams are a particularly variable species in terms of their numbers and are of great cultural importance locally, particularly in the Bijagos Islands in Guinea-Bissau.*

## Which indicators have been identified and why ?

Due to their low mobility and their sensitivity to environmental changes and various forms of pollution, shellfish are generally considered to serve as good bio-indicators of an ecosystem's overall state of health.

The health and replenishment capacity indicators selected for these monitoring activities are:

- abundance: density or biomass; and
- individual sizes: average size and outer limits.

Generally speaking, an increase in abundance or in the average size of shellfish can be interpreted as signifying an improvement in the health and replenishment capacities of the populations. Conversely, a decrease in these indicators can be considered indicative of a deterioration in these characteristics.

However, these measurements are not homogeneous, because the population of a given species of shellfish comprises individuals of different ages. Whence the interest of supplementing these with an estimate of the size structure of the population, which is a more accurate indicator of trends.





NB:

**Definition of an indicator :**

An indicator is an evaluation tool and a decision-making aid that makes it possible to assess a situation at a given point in time, over time and/or space, with relative objectivity. It is designed to be a sort of summary of complex information that offers different players (scientists, managers, politicians and citizens) the opportunity to communicate with one another.

**Definition of a bio-indicator:**

A bio-indicator is a tool used to assess the quality of the environment. It consists of a plant, animal or fungal species or species group whose presence or condition provides information on certain ecological characteristics of the environment or on the impact of certain practices.

## What types of monitoring have been selected ?

The monitoring will primarily aim to highlight the evolution of indicators over space and time, rather than estimating the total biomass of the shellfish present within an MPA. Within this context, two types of monitoring are possible: direct (using samples taken in the field) and indirect (based on information gathered in the villages).

Indirect monitoring is based on descriptions of collection activities: place and date of collection, weight or number or volume, time spent collecting a given weight or volume of shellfish (the 'harvest'), etc. This method requires that information on collections be shared and gathered regularly, which would be difficult to envisage at the present time.

Direct monitoring is based on samples taken in the field. It includes a number of steps:

1. Selecting the collection sites;
2. Collecting shellfish from pre-determined surface units or support units;
3. Counting, measuring and sorting the samples by size class; and
4. Producing size structure bar graphs.

This method, which requires ad hoc operations in the field, is the method selected for shellfish monitoring in West African MPAs under this programme.



# What are the sampling strategies?

## Sampling strategy over space:

Within each MPA, a mix of sites will be selected based on local knowledge and available information. These sites will vary in terms of:

- **habitat:** sites favourable to and used by the target species;
- **use patterns:** collection sites with varying levels of exploitation;
- **management:** sites that may be covered by existing management rules.

Zones that are unused or little used for collection (due to difficult access or a management rule) may be used to obtain basic or baseline indicators in terms of abundance and size.

## Sampling strategy over time:

**An initial intensive** monitoring phase (every month) will be conducted over the course of one year. This phase will be used to gather baseline biological data and to describe the natural seasonal cycle (seasonality of reproduction and growth) and the collection cycle of shellfish populations.

**A second seasonal** monitoring phase will be undertaken in the following years (every 2 to 4 months). This phase will enable an assessment of interannual evolution (natural and collection patterns) which will serve as the basis for the development and evaluation of sustainable management measures for shellfish collection.

# What are the expected results?

The results expected from the monitoring can be defined more specifically:

1. Evaluation of the abundance and size of the target species;
2. Evaluation of the evolution of these two indicators over the monitoring period;
3. Measurement of the influence of natural variability (reproduction) on this evolution;
4. Measurement of the scale and the impact of collection activities on this evolution;
5. Provision of information to guide and accompany the implementation of sustainable shellfish management measures;
6. Evaluation of the MPA's contributions to shellfish renewal; and
7. Provision of simple methods for shellfish evaluation for the users / collectors, that are technically and financially within their reach.

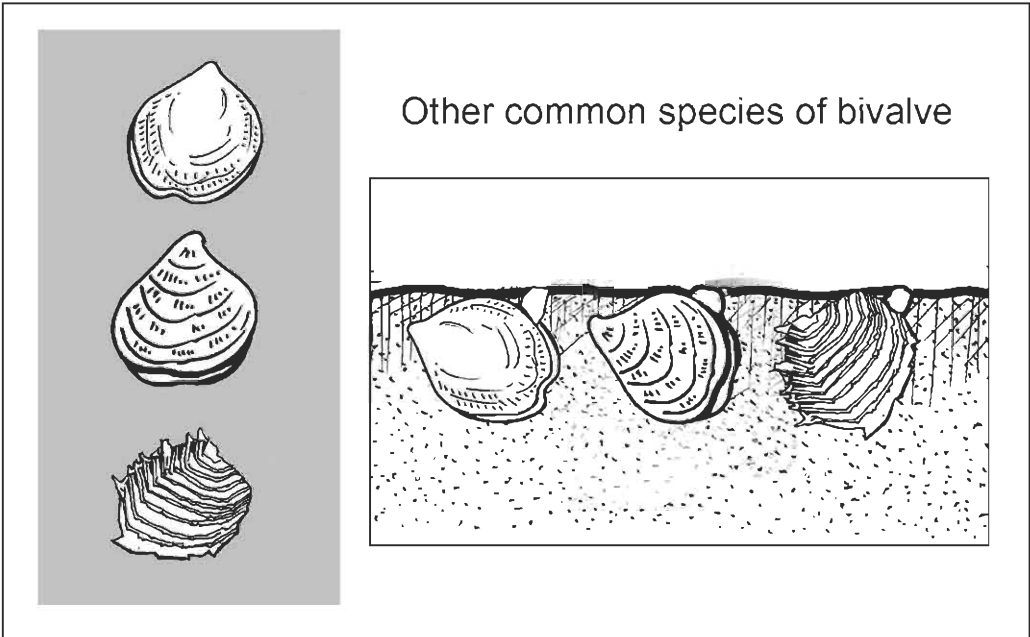
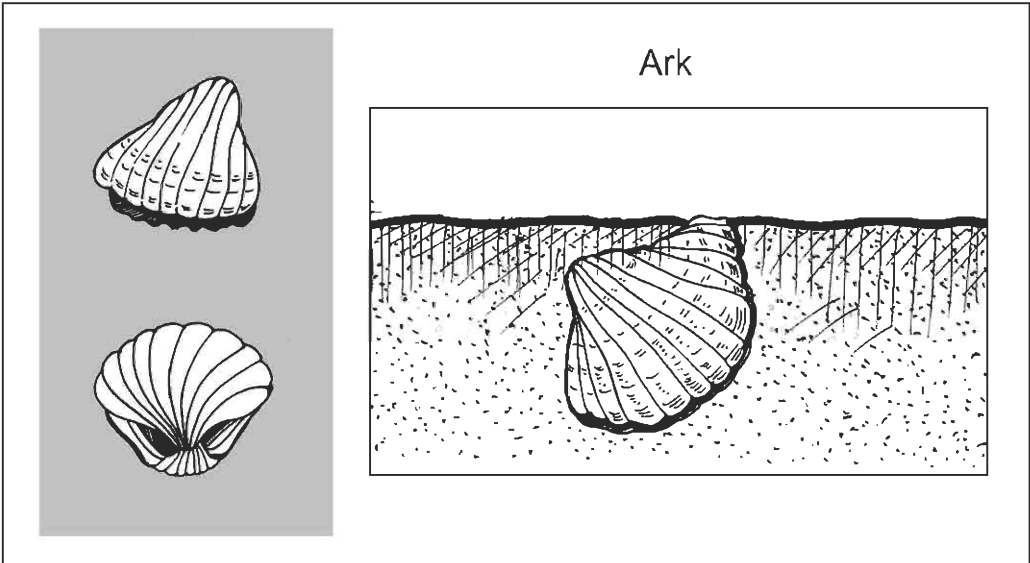


# 2. Monitoring methods

## 2.1 Participatory monitoring of ark clams and other bivalves



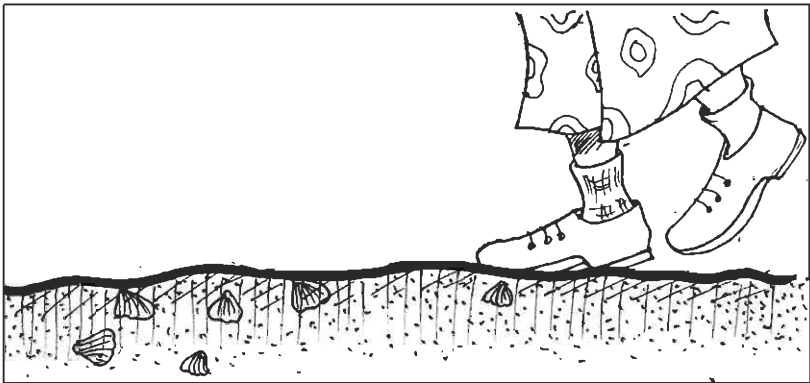
### Presentation of the species



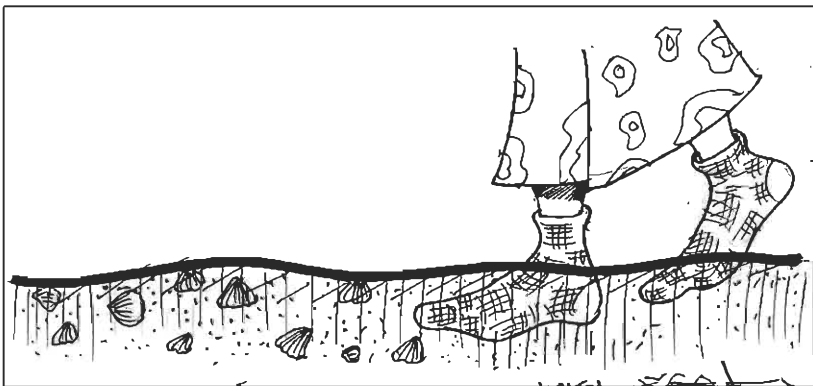


Ark clams and other bivalves can be found in different types of substrates :

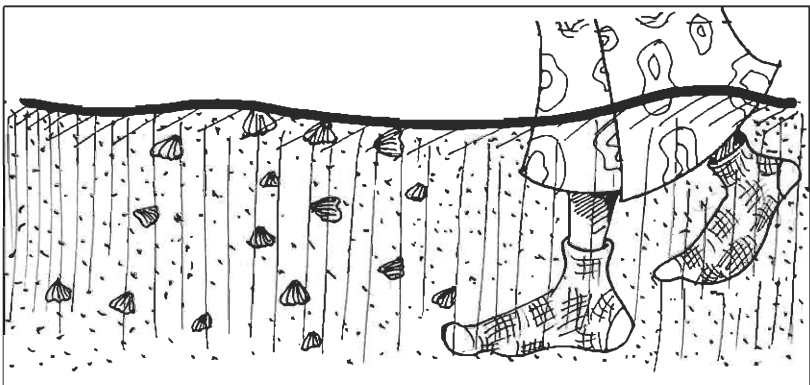
Sand (S)



Muddy sand (MS)



Muddy (M)



*NB: To be able to walk more easily without hurting your feet, we recommend wearing socks/boots for muddy sand and/or muddy substrates, rather than shoes.*

## Step 1: Participatory selection of monitoring sites



You will need to make sure that the target species are indeed present in the mud flats.



**Three (3) sites will need to be selected:**

### **1. A heavy use mud flat**

In general, these tend to be nearby the village and are accessible at all times of day.



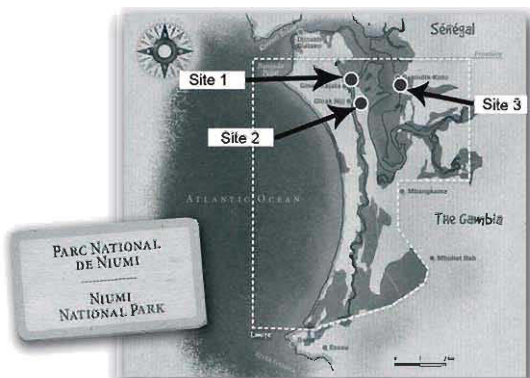
### **2. A moderate use mud flat**

These are only accessible at low tide, during the day (going there and back before the sun sets), or collection is only possible from a boat.



### **3. A low or no use mud flat**

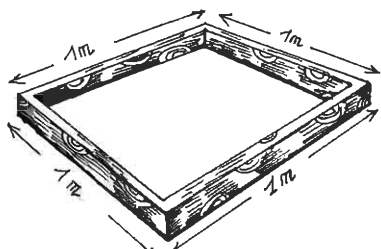
This low usage may be the result of limited access (due to distance for example) or consensus for monitoring reasons.



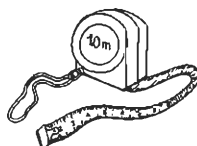
Once these 3 sites have been chosen, they will need to be characterised: geographic coordinates (GPS) and mapping.



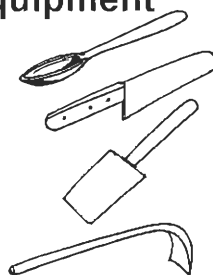
## Step 2 : Preparation of monitoring equipment



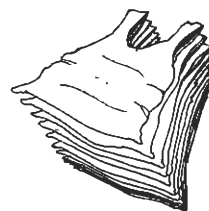
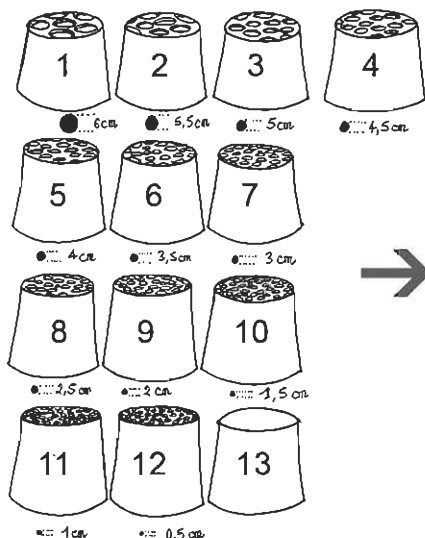
a 1 m² quadrat



a 10 m tape measure



collection tools  
(spoons, scrapers or other  
traditional implements)



20 biodegradable  
or reusable bags  
(if the samples need  
to be brought back)

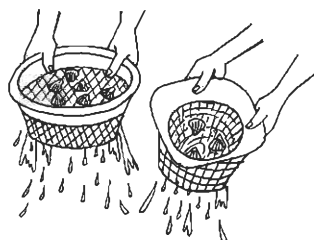
a stack of sieves (13 buckets, 12 having holes  
that vary in size from 0.5 to 6 cm and  
the 13th placed at the bottom of the stack)



recipients



work clothes for each collector  
(shoes or socks)



baskets for sample washing



field forms on a firm  
writing support + pens





## Step 3: Application of the data collection protocol

### Going to the site

1. Gather your team members together: 8 collectors with solid experience in locating ark clams.
2. Explain the tasks.
3. Go to collect your samples at the best time for starting the work, when the tide is going out, in order to complete the entire protocol without running the risk of being caught out by the tide.

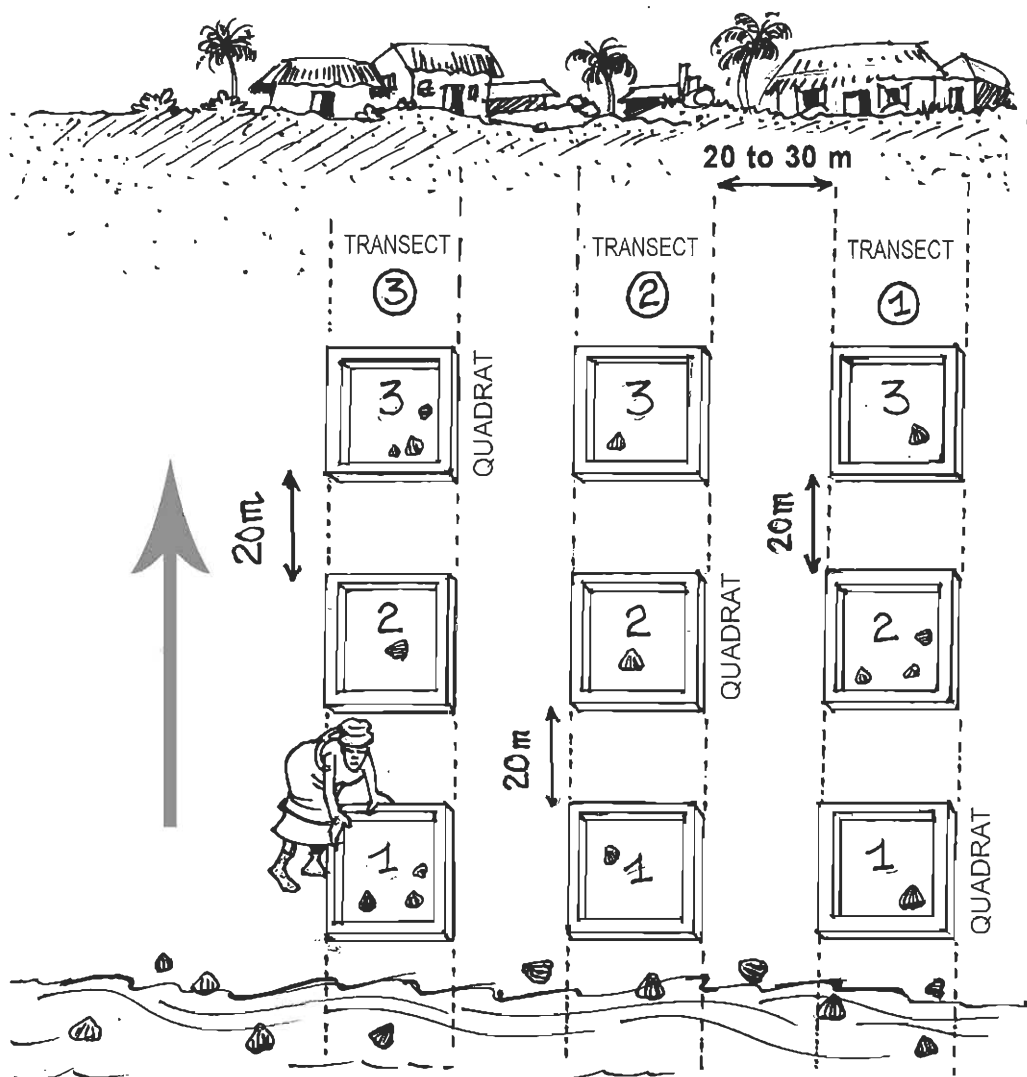


## Preparing the transects

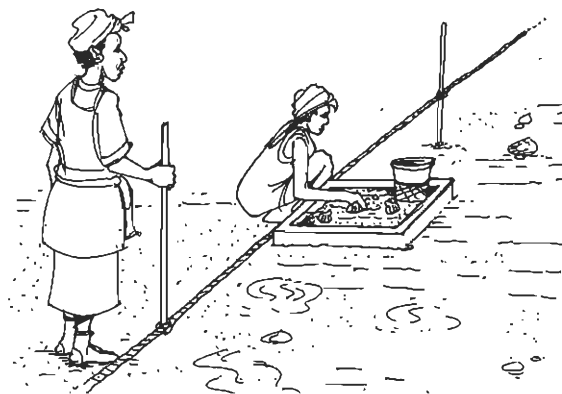
1. Plan for three (3) or four (4) transects depending on the size of the mud flat (the transects should be 20 to 30 metres apart).
2. Align the transects from the edge of the channel to the outer limit of high tide.
3. Number the transects.
4. Determine the type of substrate (cf. page 12).

## Preparing the quadrats

1. Plan the total number of quadrats for each transect based on its length (the quadrats should be 20 m apart).
2. Number the quadrats in the direction of the transect's orientation (from the sea toward the shore).

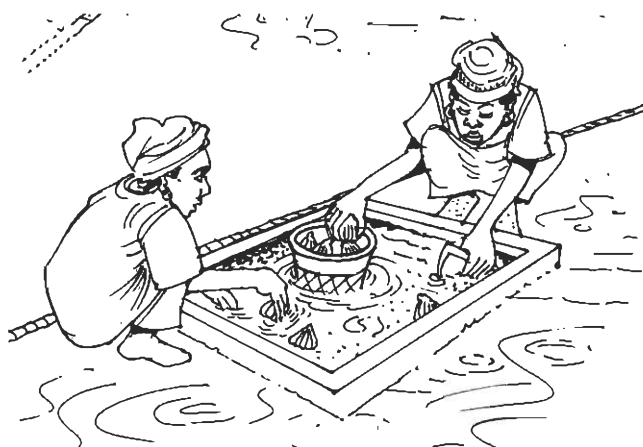


## Collecting ark clams in the quadrat



*NB: Depending on the substrate type, collection may be done by hand or using various tools (cf. page 14).*

**Collect all the ark clams and place them in the same recipient.**

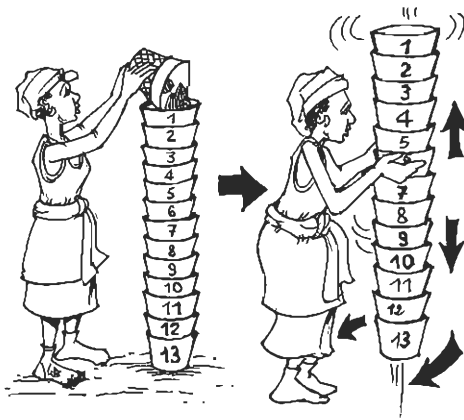


**Clean them off to eliminate any remaining substrate.**





**Sort by size class (for the indicator), using the stack of buckets.**



Run all the collected ark clams through the stack of buckets by shaking them.

*NB: If a large number were collected per quadrat, divide them into smaller groups for sorting.*

**Count the number of individuals remaining in each bucket.**



Depending on the particular features of the MPA, the collected shellfish may be returned to the sites (in fully protected areas) or processed by the female members of the team (in areas where collection is allowed).

*NB: In the interest of conservation, smaller individuals must always be left on site.*

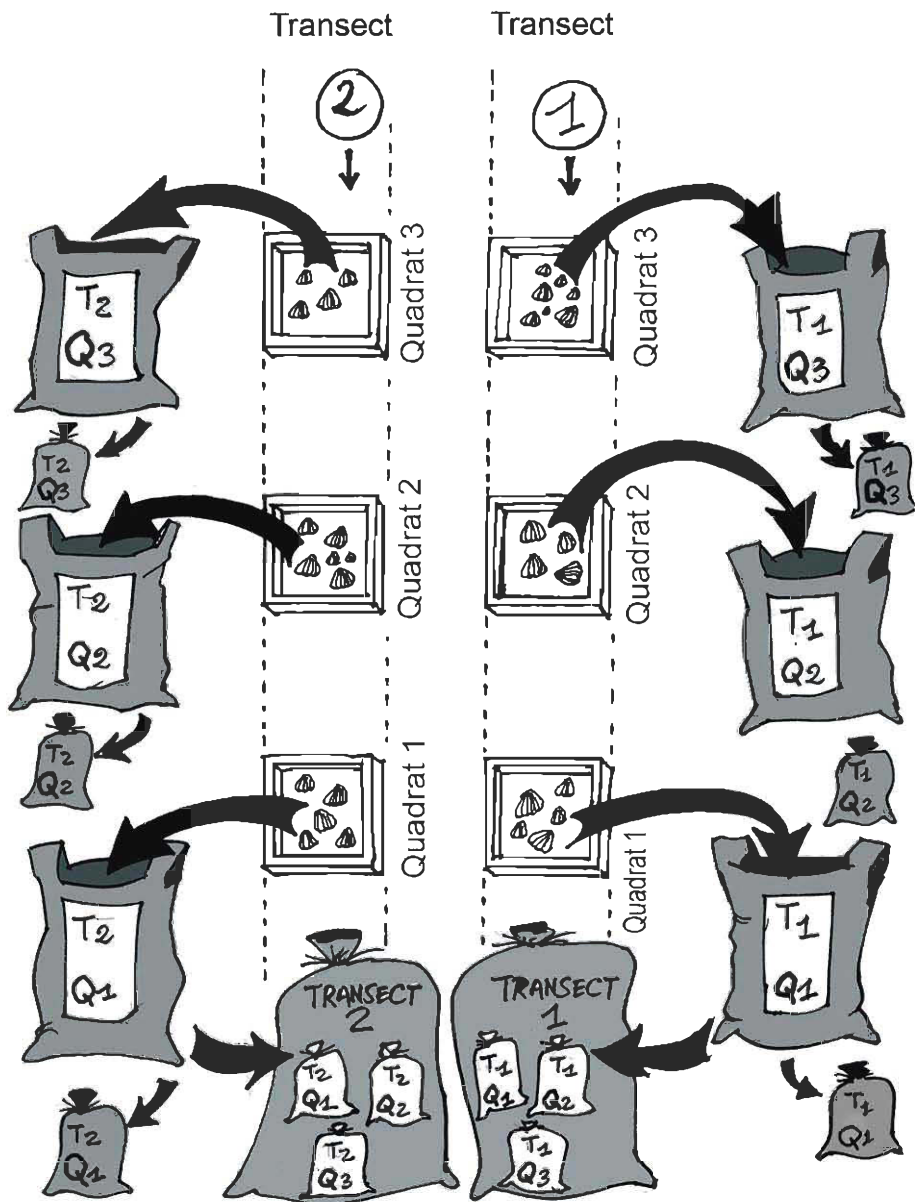
**Consigner le nombre obtenu sur la fiche de terrain**



**The same process must then be repeated for each quadrat along each transect.**

If the weather or the tides make it impossible to complete all these actions in the field, you can wait to sort for the size indicator until you have returned to the village. In this case, certain precautions will need to be taken :

1. Separate the ark clams collected by quadrat in bags, noting the quadrat and transect numbers on each one.
2. Group all samples from the same transect in a single recipient.
3. Return to the village.

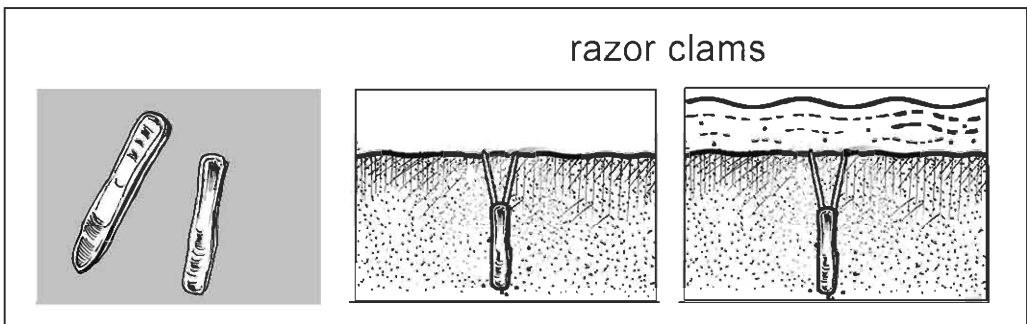
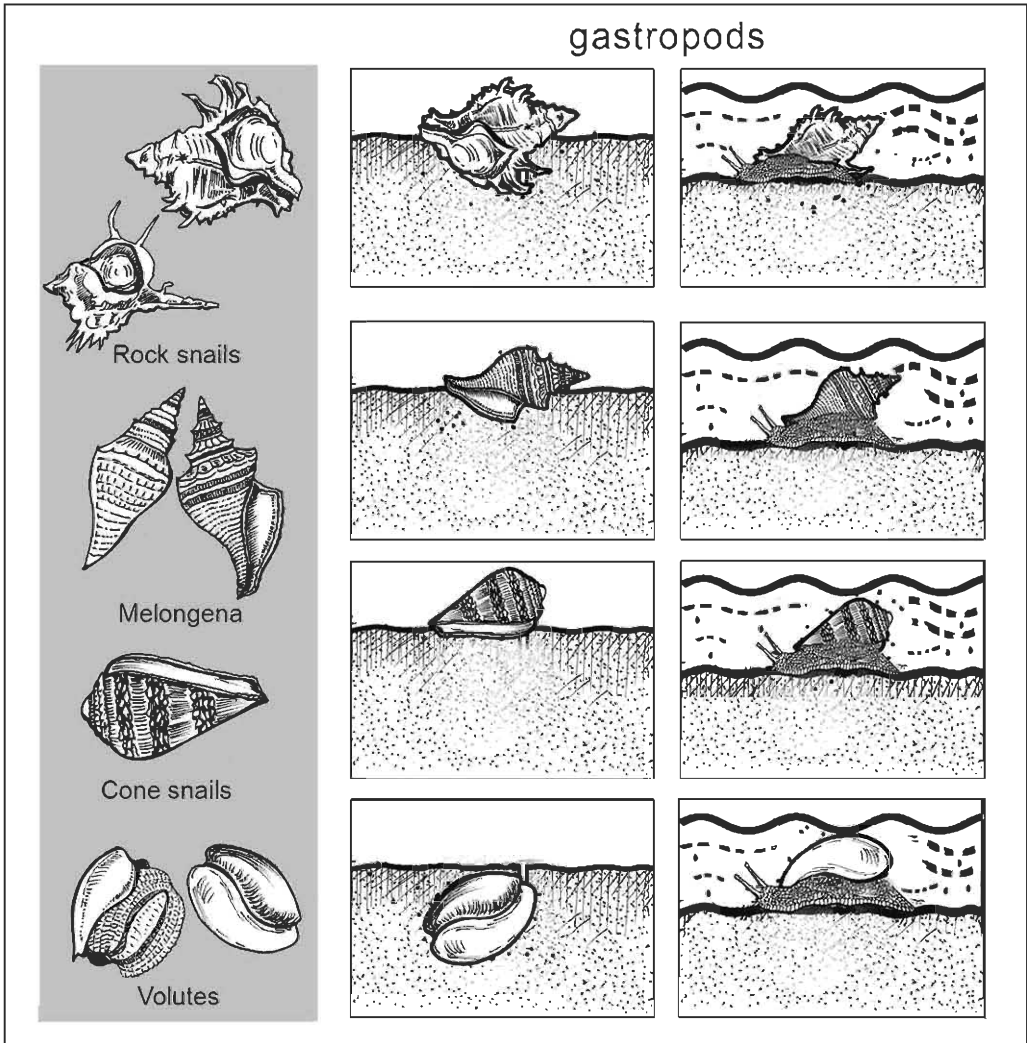


# Field form for tracking arches (or other bivalves)

Documenter name:	Site name:			Monitoring date:			Time of collection:			Time of low tide:					
<b>Transect</b>	<b>T1</b>			<b>T2</b>			<b>T3</b>			<b>TX</b>			<b>TX</b>		
<b>Quadrat</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>QX</b>	<b>QX</b>	<b>QX</b>	<b>QX</b>	<b>QX</b>	<b>QX</b>
<b>Position</b>															
<b>Substrate</b>															
<b>Number of individuals per size class (mm)</b>															
<b>&gt; 60</b>															
<b>55-60</b>															
<b>50-55</b>															
<b>45-50</b>															
<b>40-45</b>															
<b>35-40</b>															
<b>30-35</b>															
<b>25-30</b>															
<b>20-25</b>															
<b>15-20</b>															
<b>10-15</b>															
<b>5-10</b>															
<b>0-5</b>															

# 2.2 Participatory monitoring of gastropods and razor clams

## Presentation of the species



## Step 1: Participatory selection of monitoring sites



You will need to make sure that the target species is indeed present in the mud flats.



Three (3) sites will need to be selected :

### 1. A heavy use mud flat

In general, these tend to be nearby the village and are accessible at all times of day.



### 2. A moderate use mud flat

These are only accessible at low tide, during the day (going there and back before the sun sets), or collection is only possible from a boat.



### 3. A low or no use mud flat

This low usage may be the result of limited access (due to distance for example) or consensus for monitoring reasons.



Once these 3 sites have been chosen, they will need to be characterised: geographic coordinates (GPS) and mapping.

**For the sake of convenience, the mud flats selected to monitor ark clams can also be used for gastropod monitoring.**



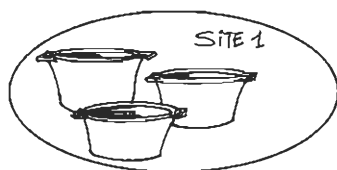
## Step 2: Preparation of monitoring equipment



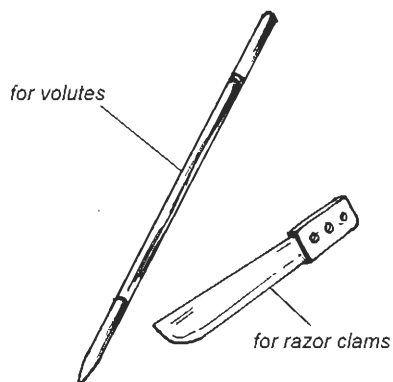
a stopwatch



biodegradable or reusable bags



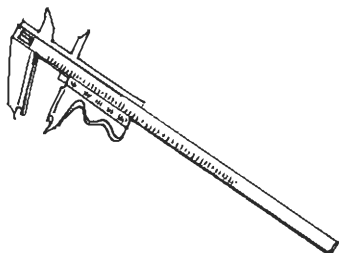
one to three recipients per collection site



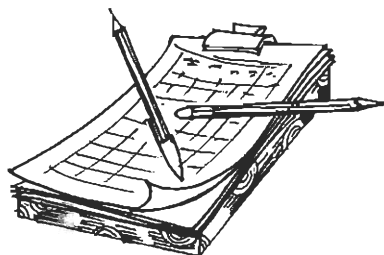
collection tools



kit for the collectors (shoes or socks)



a calliper rule or a ruler

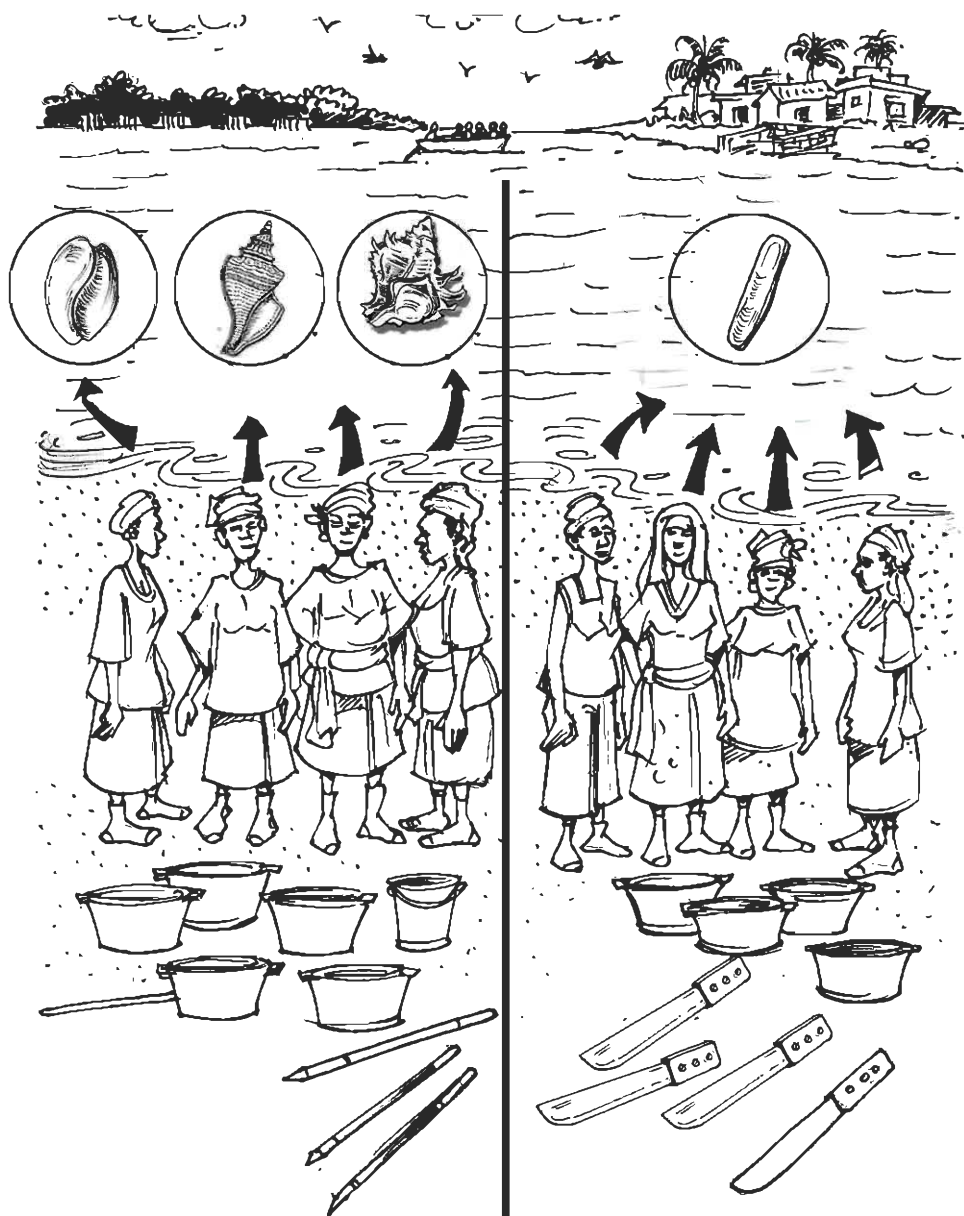


field forms on a firm  
writing support + pens

## Step 3: Application of the data collection protocol

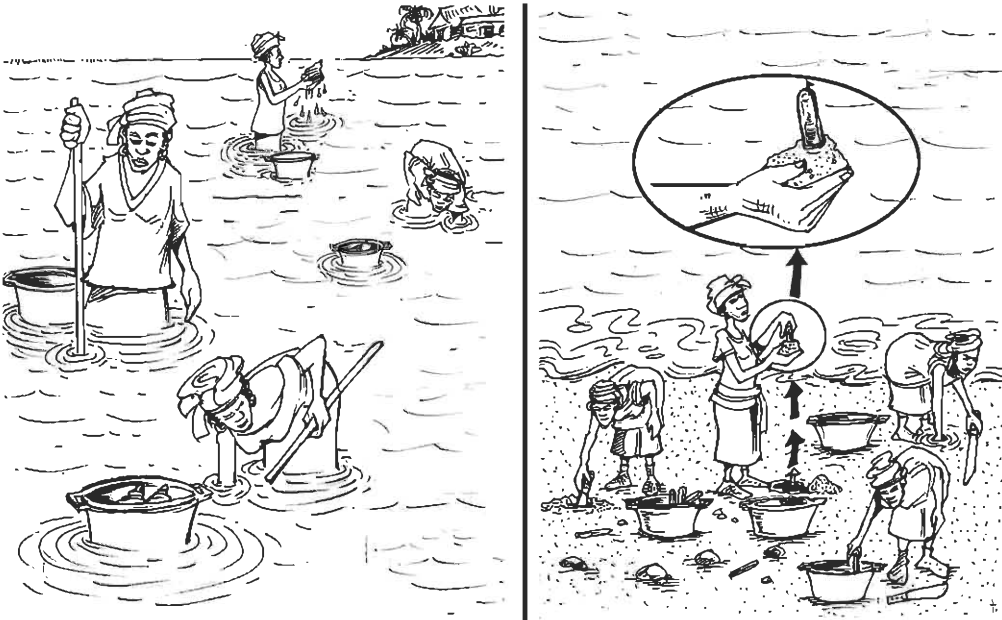
### Going to the site

1. Gather your team members together:
  - 4 collectors with solid experience in locating gastropods;
  - 4 collectors with solid experience in locating razor clams.
2. Explain the tasks.
3. Go to collect your samples at the best time for starting the work, when the tide is going out; this is especially important for gastropod monitoring. Razor clams are easiest to locate when the water has completely receded.

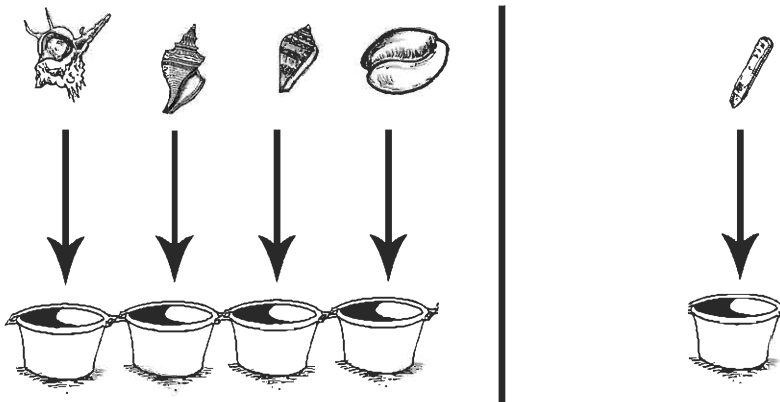


# Collecting the gastropods and razor clams

11. Pick up gastropods and razor clams on the mud flat at random, at the same time, during 30 minutes.

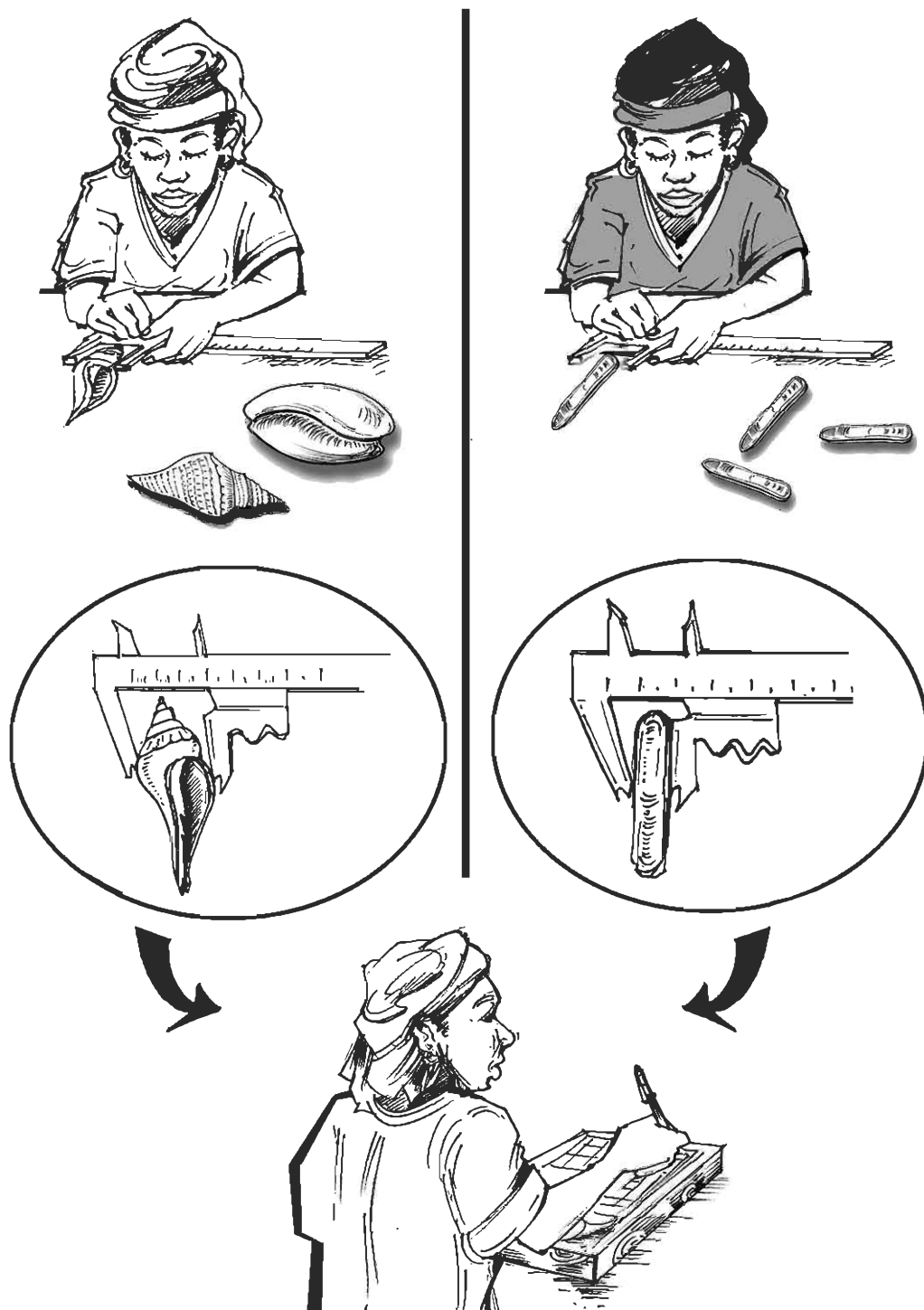


22. Group the molluscs into different containers by species at the end of the allotted 30 minutes.



## Measuring size (width)

Measure the width of each individual using a calliper rule and record the results on the field form (number of individuals per size class).



Field form for gastropod (melongena, volute and rock snail) and razor clam monitoring

Species:

Nom du rapporteur :		Nom du site :				Date du suivi:				Heure de collecte :				Durée :			
Classe de taille (mm)	Nombre par tranche de taille (à défaut, une coche par individu dans la case correspondante)																Nombre total
75-80																	
70-75																	
65-70																	
60-65																	
55-60																	
50-55																	
45-50																	
40-45																	
35-40																	
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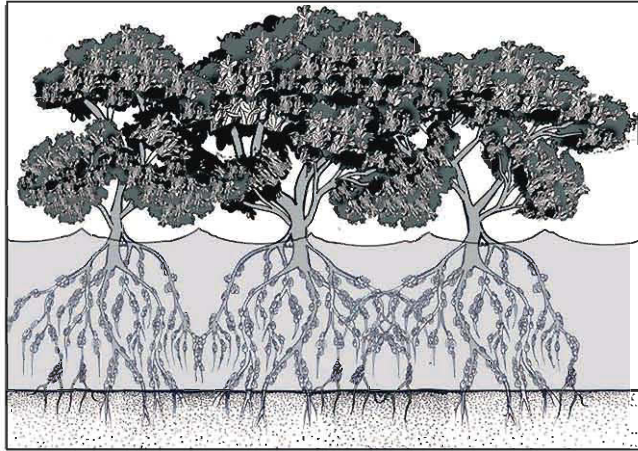
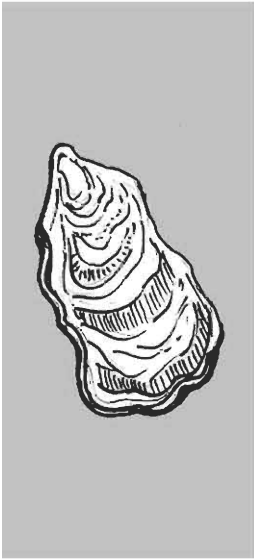


## 2.3. Participatory monitoring of oysters

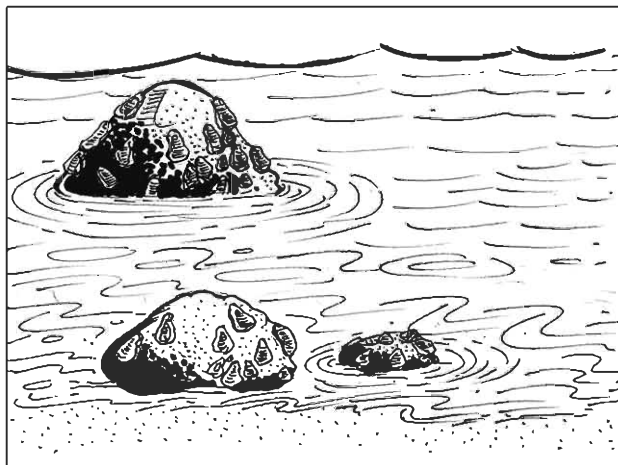
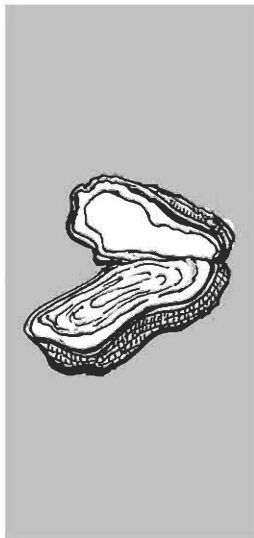


### Presentation of the species

Mangrove oysters



Rock oysters



## Step 1: Participatory selection of monitoring sites



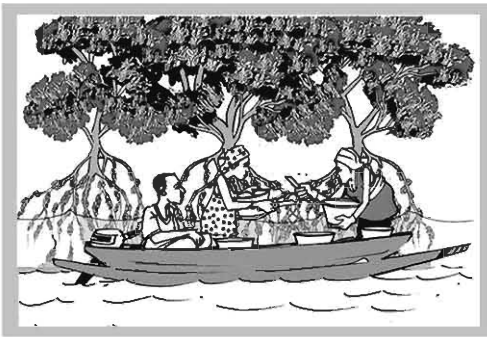
You will need to make sure that the target species is indeed present in the bolongs (on the roots of the mangroves).



Three (3) sites will need to be selected:

### 1. A heavy use bolong

In general, these tend to be nearby the village and are accessible at all times of day.



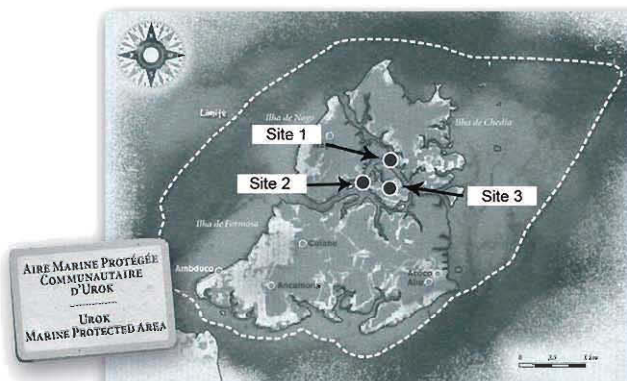
### 2. A moderate use bolong

These are only accessible at low tide, during the day (going there and back before the sun sets), or collection is only possible from a boat.



### 3. A low or no use bolong

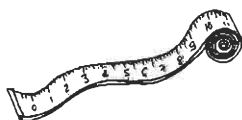
The reason for this low usage may be distance or a consensus for monitoring reasons.



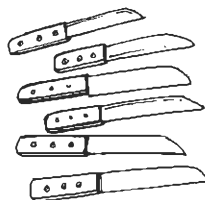
Once these 3 sites have been chosen, they will need to be characterised: geographic coordinates (GPS) and mapping.



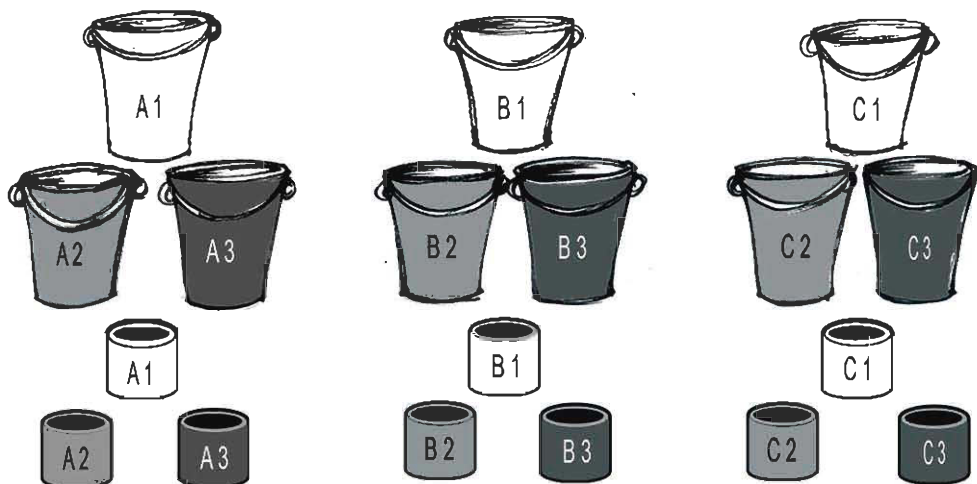
## Step 2: Preparation of monitoring equipment



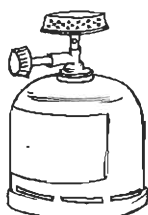
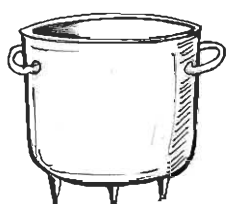
a tape measure



6 knives or machetes



9 buckets and 9 cups (numbered)



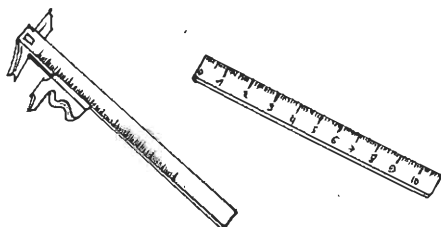
a cooking pot  
and a burner (gas or wood fired)



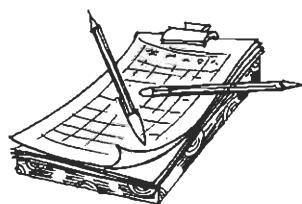
gloves



a pirogue (if necessary)



1 or 2 calliper rules, electronic if possible  
(if not, a ruler)



field forms on a firm  
writing support + pens

## Step 3: Application of the data collection protocol

### Going to the site

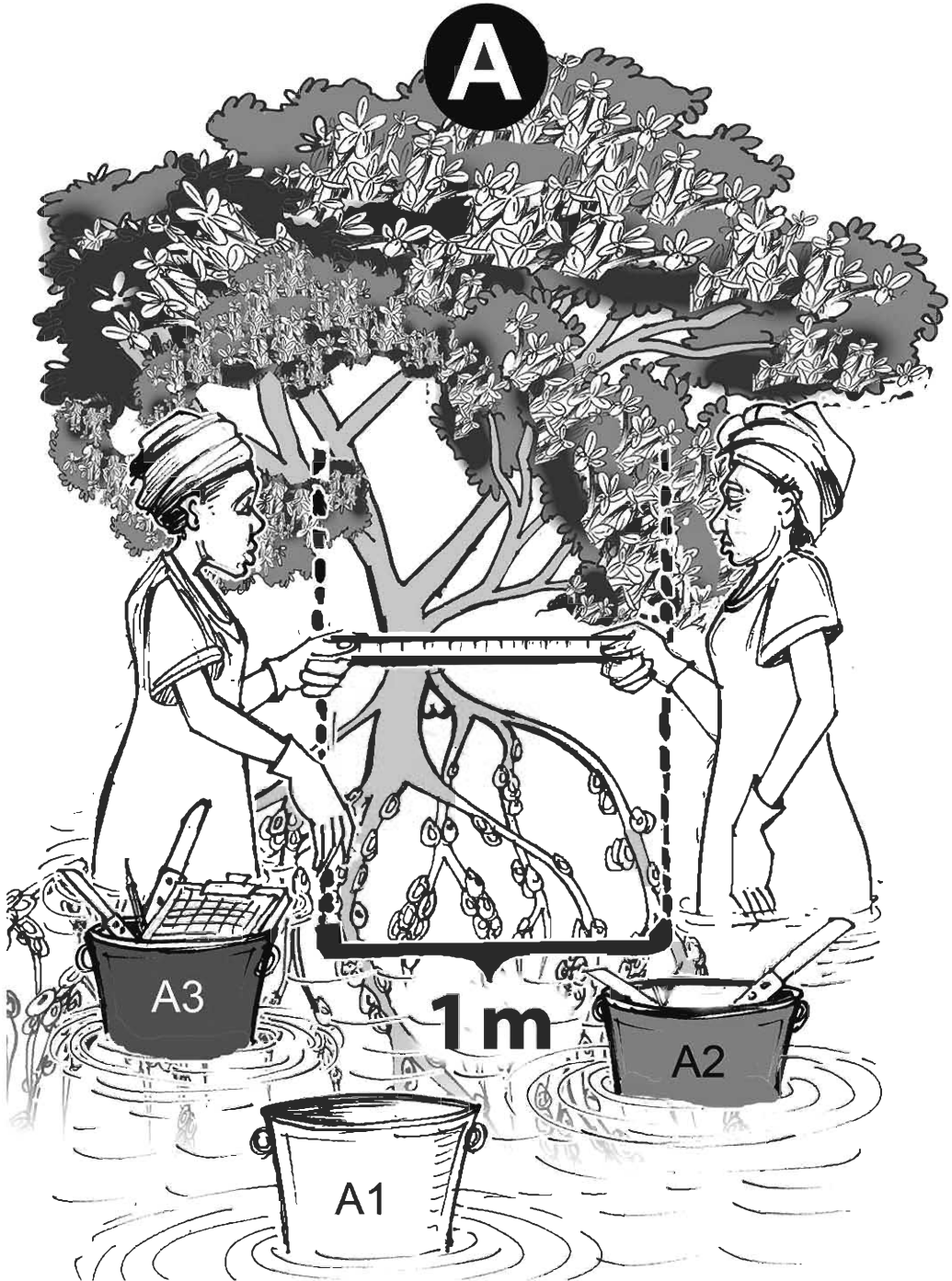
1. Gather your team members together: 2 collectors with solid experience in collecting oysters.
2. Explain the tasks.
3. Go to the sites by boat or on foot at low tide in order to accurately assess the prop roots colonised by oysters.





## Arranging the transects for the first collection point

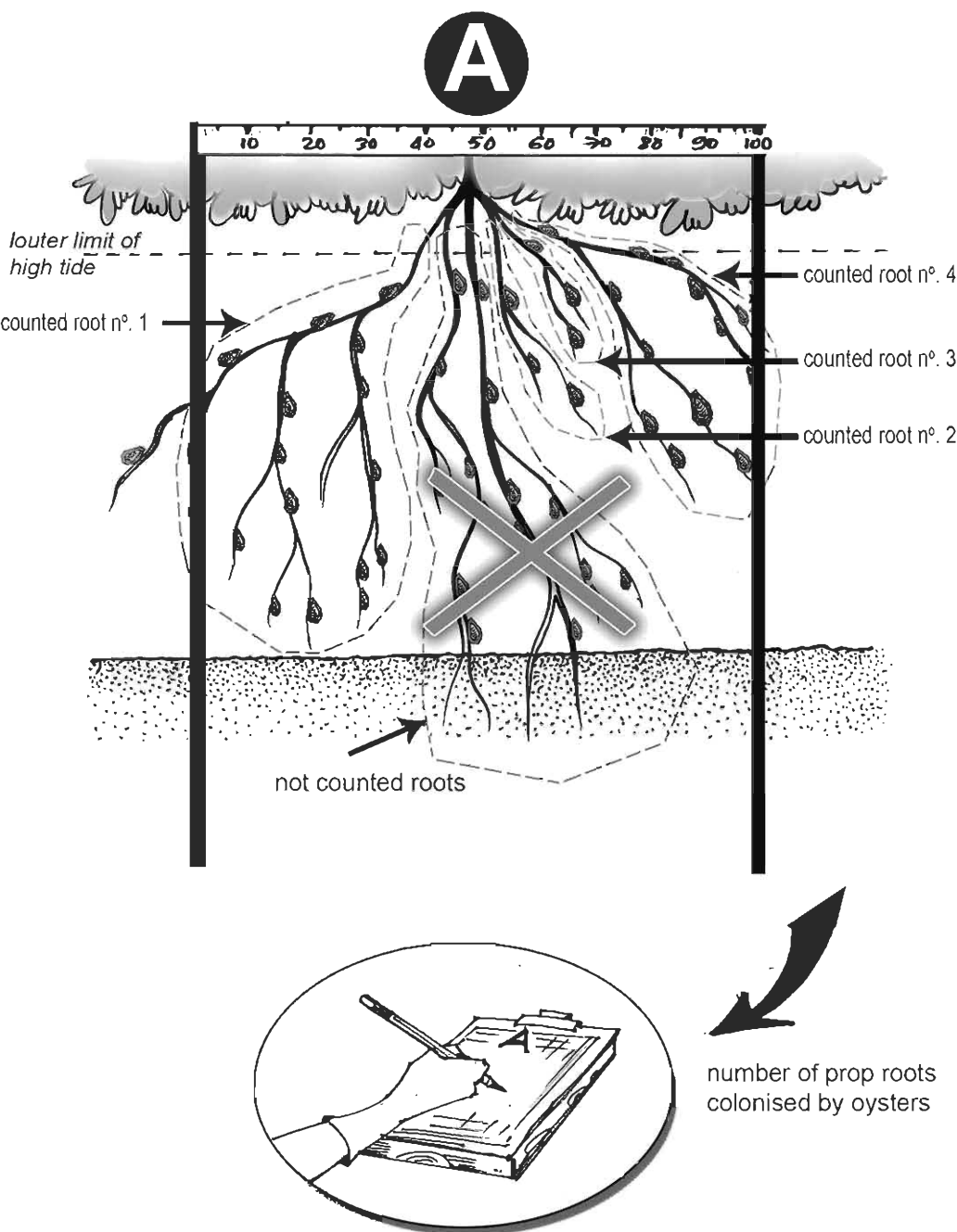
1. Choose a starting point (point A) at the collection site.
2. Define an area one metre wide on the mangrove roots.





# Counting the prop roots colonised by oysters

- 1. Count the number of prop roots colonised by oysters in this area (A), whose extremities are not in the mud (always begin at the outer limit of high tide as marked by the first leaves toward the base).
- 2. Record the number of prop roots colonised by oysters on the field form.



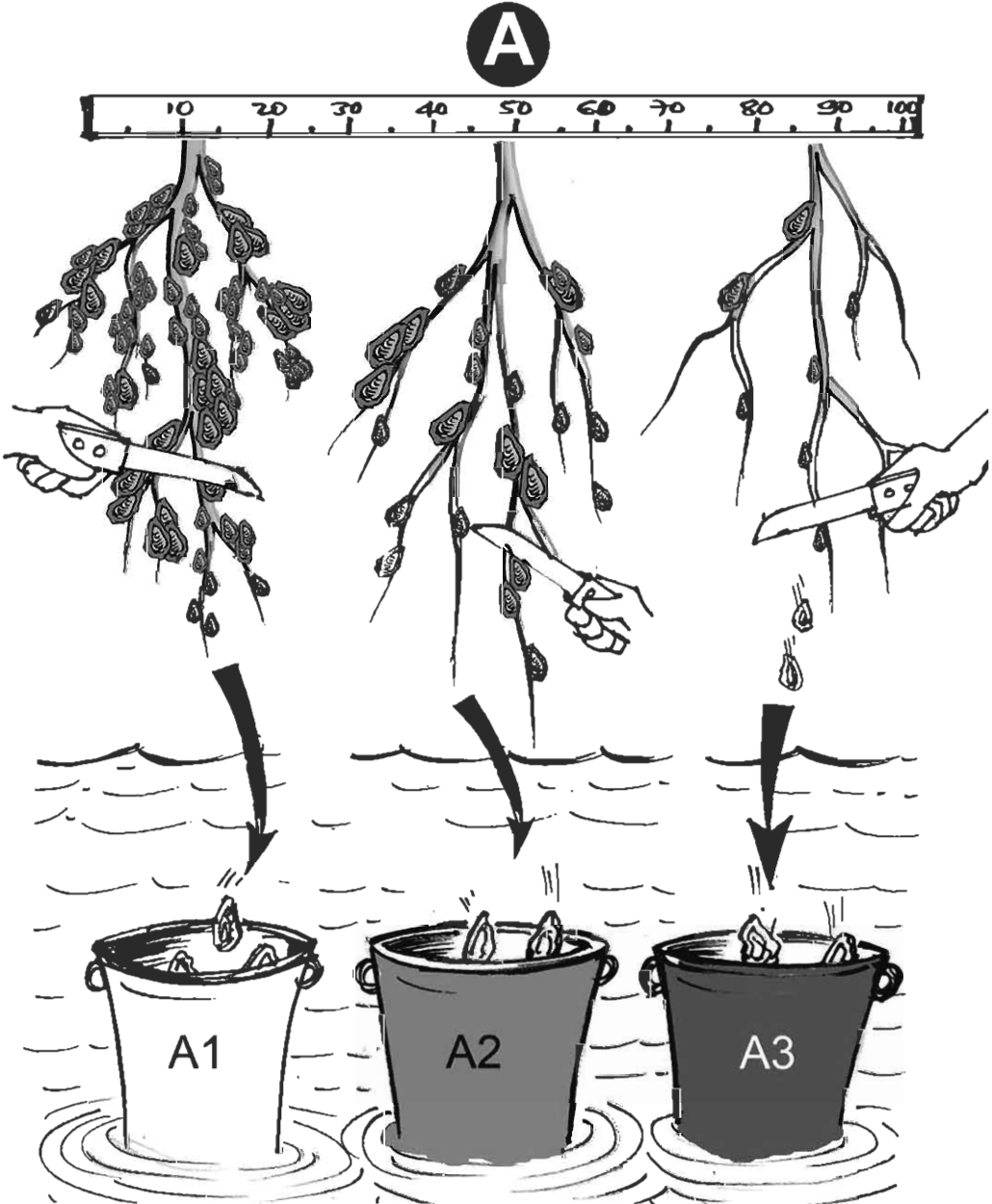
## Selecting the prop roots

Choose 3 types of roots based on the quantity of oysters colonising them:

- the most heavily colonised prop root (A1);
- a moderately colonised prop root (A2); and
- the least colonised prop root (A3).

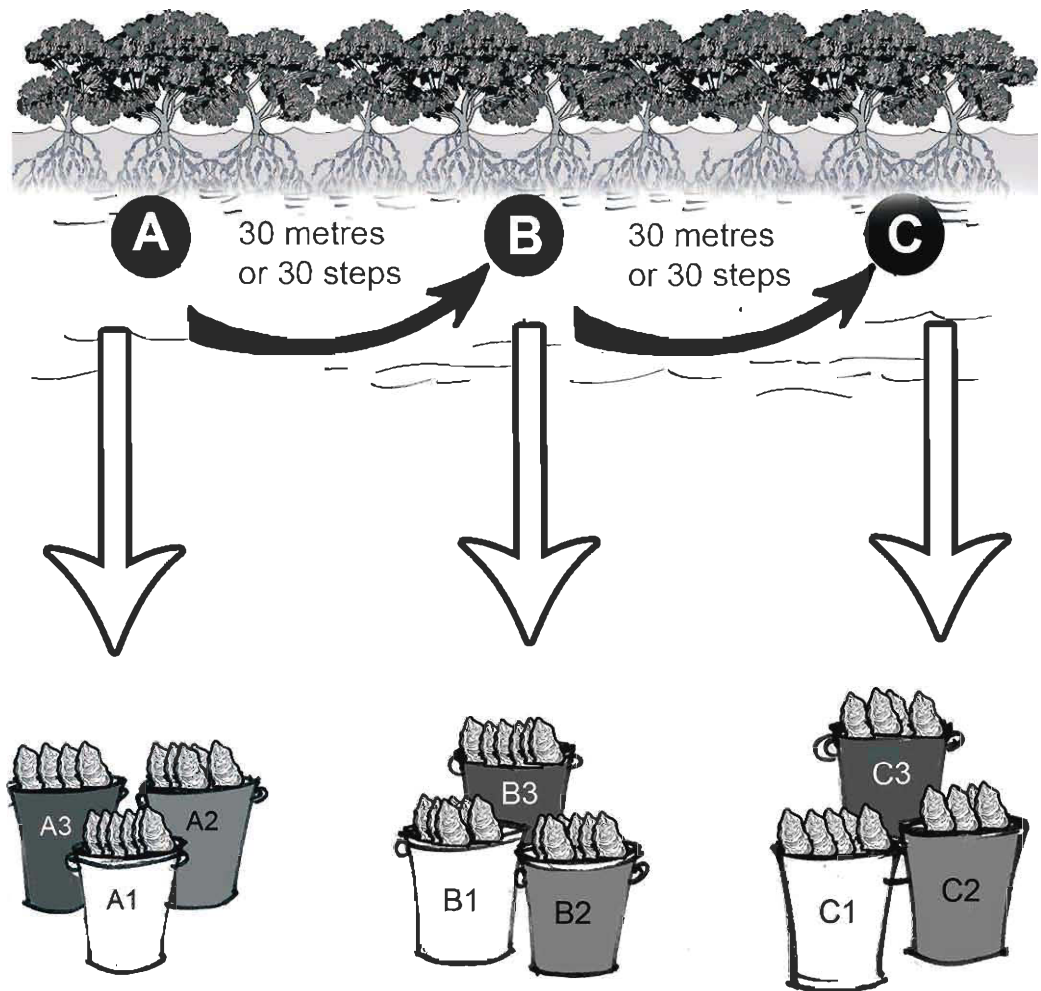
## Detaching the oysters from the roots at the collection point (A)

Remove all oysters from each of the 3 previously selected roots (A1, A2 and A3) and place them in the corresponding buckets.



### Set up the transects at two other collection points (B and C)

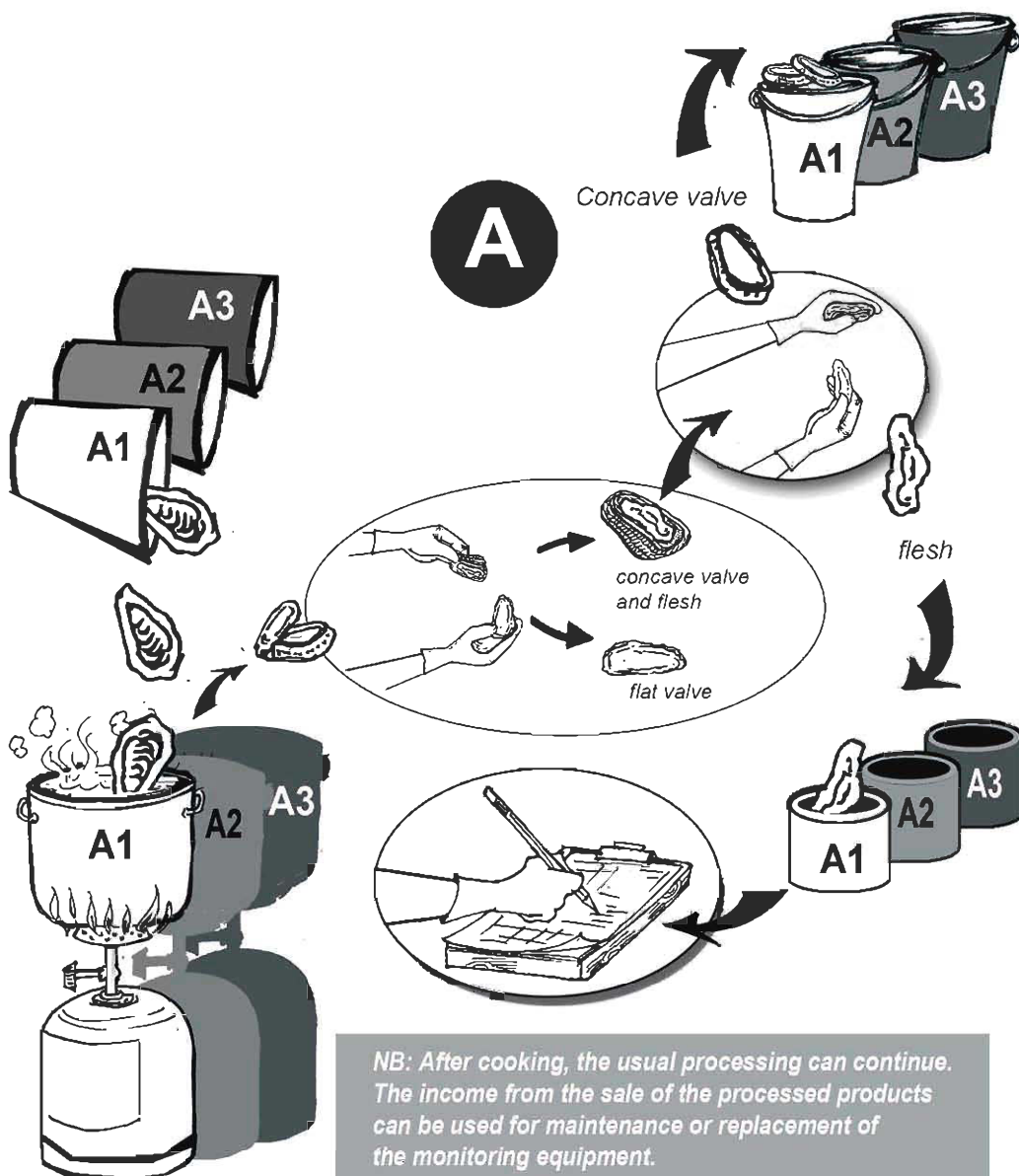
1. Move a distance of 30 m or 30 steps for the second collection of oysters (point B).
2. Repeat the previously described actions to obtain three (3) samples: B1, B2, and B3.
3. Move another distance of 30 m or 30 steps for the third collection (point C).
4. Repeat the previously described actions to obtain three (3) samples: C1, C2 and C3.



## Counting the oysters back at the village

1. Cook the oysters in a little water or grill them, separately for each bucket (A1, A2, A3 then B1, B2, B3 and finally C1, C2, C3).
2. Remove the flesh of each oyster and place it in the corresponding cup.
3. Count the number of individuals per cup and record it on the field form.

**NB : Oysters will open after a few minutes cooking.**

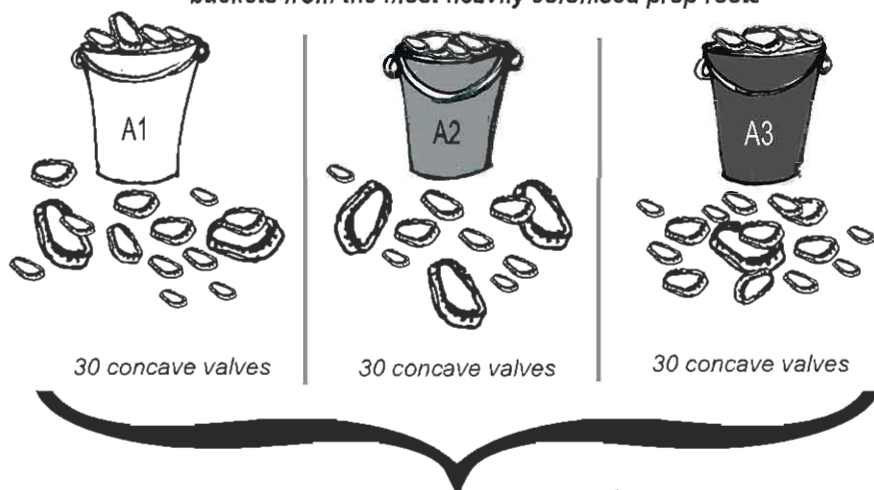


**Repeat this process for groups B and C**

## Measuring oyster size (width)

1. Select 30 shells/concave valves from each of the buckets from the most heavily colonised prop roots (A1, B1 and C1) and measure their width using a calliper rule (if fewer than 30, measure all of them).
2. Record the results on the field form.

*buckets from the most heavily colonised prop roots*



Repeat this process for the buckets from the roots with a moderate level of colonisation (A2, B2 and C2), then for the buckets from the least colonised prop roots (A3, B3 and C3).



## Field form for mangrove oyster monitoring

Observateurs :		Nom du site :		Date du suivi :		Heure de la collecte :		Heure de marée basse :	
ABONDANCE				TAILLE : Nombre d'individus par classe de taille (mm)					
Mètre linéaire n°	A	B	C	Mètre linéaire n°	A	B	C		
Nombre de racines				75-80					
				70-75					
Nombre d'individus sur la racine la plus chargée (A1,B1, C1)				65-70					
				60-65					
Nombre d'individus sur la racine moyennement chargée (A2,B2, C2)				55-60					
				50-55					
Nombre d'individus sur la racine la moins chargée (A3, B3, C3)				45-50					
				40-45					
				35-40					
				30-35					
				25-30					
				20-25					
				15-20					
				10-15					
				5-10					
				0-5					



# 3. Data processing and reporting

Data processing includes database creation and additions, along with data analysis. All of this can be done through Excel or any other data processing software of your choice.

## 3.1 Database creation

A database is creating by entering the observations recorded on the field forms for the different species (ark clams, gastropods and oysters) on a spreadsheet (such as in Excel). After each monitoring activity, all field forms must be entered for the entire action and then archived.

### Sample Excel databases (Tables 1, 2 and 3)

Table 1: Template for ark clams

Monitoring date	Site name	Substrate type	Transect no.	Quadrat no.	Genus	Species	Local name	Size	Number
					Anadara	senilis		> 60	
					Anadara	senilis		55-60	
					Anadara	senilis		50-55	
					Anadara	senilis		45-50	
					Anadara	senilis		40-45	
					Anadara	senilis		35-40	
					Anadara	senilis		30-35	
					Anadara	senilis		25-30	
					Anadara	senilis		20-25	
					Anadara	senilis		15-20	
					Anadara	senilis		10-15	
					Anadara	senilis		5-10	
					Anadara	senilis		0-5	

Table 2: Template for gastropods

No.	Monitoring date	Site name	Substrate type	Genus	Species	local name	Size (mm)	Number
1				<i>Pugilina</i>	<i>morio</i>		< 10	
2				<i>Pugilina</i>	<i>morio</i>		10-15	
3				<i>Pugilina</i>	<i>morio</i>		15-20	
4				<i>Pugilina</i>	<i>morio</i>		20-25	
5				<i>Pugilina</i>	<i>morio</i>		25-30	
6				<i>Pugilina</i>	<i>morio</i>		30-35	
7				<i>Pugilina</i>	<i>morio</i>		35-40	
8				<i>Pugilina</i>	<i>morio</i>		40-45	
9				<i>Pugilina</i>	<i>morio</i>		45-50	
10				<i>Pugilina</i>	<i>morio</i>		50-55	
11				<i>Pugilina</i>	<i>morio</i>		> 55	

*NB: This same template can also be used for razor clams.*

Table 3: Template for oysters

No.	Monitoring date	Site name	L.m. no.	Genus	Species	local name	Size (mm)	Number
1				<i>Crassostrea</i>	<i>gasar</i>		< 10	
2				<i>Crassostrea</i>	<i>gasar</i>		10-15	
3				<i>Crassostrea</i>	<i>gasar</i>		15-20	
4				<i>Crassostrea</i>	<i>gasar</i>		20-25	
5				<i>Crassostrea</i>	<i>gasar</i>		25-30	
6				<i>Crassostrea</i>	<i>gasar</i>		30-35	
7				<i>Crassostrea</i>	<i>gasar</i>		35-40	
8				<i>Crassostrea</i>	<i>gasar</i>		40-45	
9				<i>Crassostrea</i>	<i>gasar</i>		45-50	
10				<i>Crassostrea</i>	<i>gasar</i>		50-55	
11				<i>Crassostrea</i>	<i>gasar</i>		> 55	

N° m. l. : Number linear metre

# 3.2 Data analysis

## Size

After each monitoring activity, calculate the number of individuals per size class. This set of figures can be presented in a bar graph, which will provide a picture of the size structure of the population of each species (ark clams, gastropods, razor clams and oysters) as at the date of monitoring.

For example, the table below presents the data obtained after sorting ark clams collected during a monitoring action.

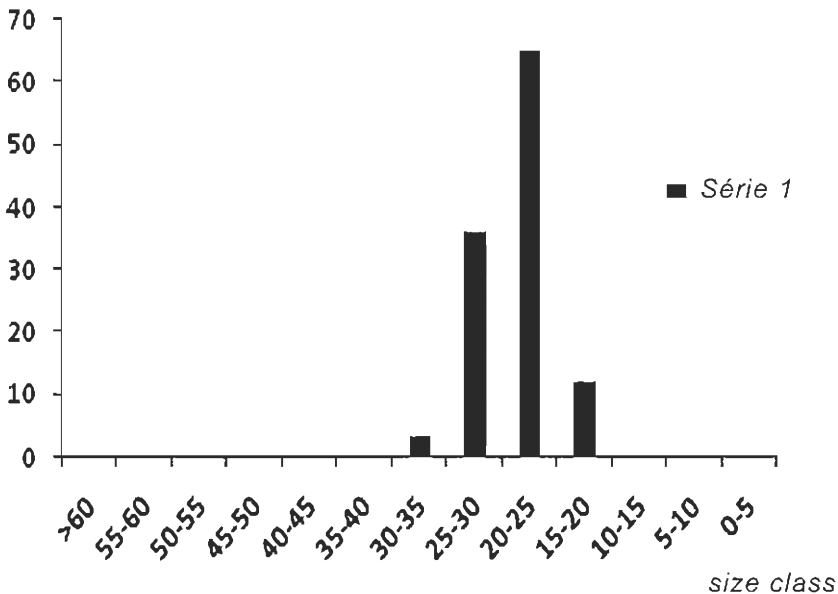
Size class	Transect 1	Transect 2	Transect 3	Total
> 60	0	0	0	0
55-60	0	0	0	0
50-55	0	0	0	0
45-50	0	0	0	0
40-45	0	0	0	0
35-40	0	0	0	0
30-35	1	1	1	3
25-30	20	6	10	36
20-25	30	12	23	65
15-20	6	4	2	12
10-15	0	0	0	0
5-10	0	0	0	0
0-5	0	0	0	0

## How is a bar graph created from an Excel spreadsheet to see a population's size structure?

You will need to :

- Select the data, i.e. the 'Size class' column and the 'Total' column with your mouse;
- Go to 'Insert' – a window will open with a number of possible graph types;
- Select 'Chart' (in this case, a type of bar graph);
- Click on the model of your choice to obtain your results;

*Number of individuals*



**NB: The chart option will give you several possibilities for organising your graph.**

After you have performed **several monitoring actions**, the **evolution** of the population's size structure can be graphically presented and analysed. In the example below (3 monitoring actions over the course of one year), it is possible to highlight the impact of :

- Reproduction: appearance of a new generation between January and July;
- Growth: increase in sizes between July and November;
- Mortality: low between January and July (numbers maintained), then higher between July and November (drop in numbers linked to the collection of individuals larger than 30 mm) ;

## **Abundance: How to calculate the abundance index :**

### **for ark clams**

Abundance index (average density) = Total individuals collected/Number of quadrats

It is expressed as: Number of individuals/m<sup>2</sup>

#### *Sample calculation*

	Transect 1	Transect 2	Transect 3	Transect 4
Quadrat 1	35	102	25	209
Quadrat 2	46	81	75	125
Quadrat 3	23	7	6	87
Quadrat 4	18	12	30	52
Quadrat 5	16	19	14	36
Total	138	221	150	509
Total	1018 ind.			
No. quadrats	20			
Abundance	$1018/20 = 50.9 \text{ ind./m}^2$			

### **for gastropods and razor clams:**

Abundance index = Total individuals collected by all collectors combined/Number of collectors

It is expressed as: Number of individuals/unit of time

#### *Sample calculation*

	Number collected
Collector 1	38
Collector 2	20
Collector 3	62
Total	120
Abundance	$120/3 = 40 \text{ ind./unit of time}$



**for oysters**

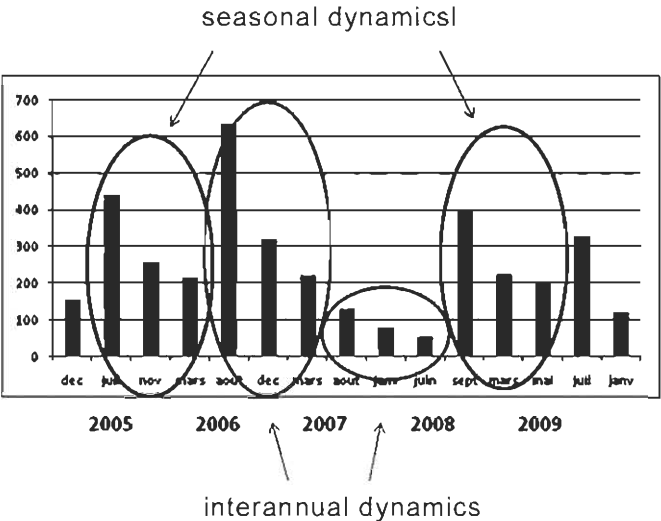
Abundance index = Average number of oysters per prop root x Number of colonised roots per linear metre

It is expressed as: Number of individuals/linear metre

*Sample calculation*

Linear metre number	1	2	3
Number of prop roots (Nc)	18	11	12
Number of individuals per maximum density root	38	95	53
Number of individuals per average density root	20	44	20
Number of individuals per minimum density root	2	12	8
Total	60	151	81
Average number of individuals per root (Ni)	60/3 = 20	151/3 = 50.3	81/3 = 27
Number of individuals per linear metre (Ni x Nc)	20x18 = 360	50.3x11 = 553.3	27x12 = 324
Average	(360+553.3+324)/3 = 412.4 ind./l.m.		

After each monitoring excursion, all abundance indices will need to be cted and recorded in a summary table. After you have performed several monitoring actions, the evolution of the population's abundance index can be graphically presented and analysed, to determine seasonal and interannual dynamics.



### 3.3 Data reporting

The monitoring results and observations will need to be reported back to the populations and the various players involved in shellfish collection on a regular basis, in order to encourage participatory discussions of decisions to be made to improve management of the resource.

For each MPA, the players will need to agree on a regulation that defines:

- the minimum size limit for each species; and
- the biological rest periods for the different species.

## 4. Recommendations for sustainable management

The monitoring system explained in this guide is to be used to implement shellfish management measures, in the interest of collection activities that are well planned and sustainable. In fact, monitoring the behaviour of shellfish populations should be a part of the everyday life of each MPA's management team. The analysis of the results of these simple, participatory evaluations will make it possible, in particular, to identify the minimum size limit for each species and to define rules and a collection calendar by consensus. It will also allow for an assessment of the impact of the management measures instituted by the MPA and thus an assessment of the latter's impact on the resource.

Once they have taken ownership of the monitoring system and its operation, the management teams will be able to:

- **inventory the various mud flats** in the area;
- establish a baseline for each mud flat;
- define a collection calendar by applying a **system of rotations**;
- implement a **fallow system** to encourage population regrowth; and
- as necessary, repopulate completely empty mud flats with ark clams recruited from other mud flats with the same type of substrate; for oysters, the set-up of garlands of empty shells can be used as an alternative. The distribution of gastropods that are ark clam predators is affected by the presence of a food supply for them.

At the subregional level, setting up a **participatory sampling system** common to all MPAs would yield comparable data that could lead to **harmonised management policies**, despite the particular features of each MPA.

# Schedule

Table presenting local names of shellfish collected in Senegal, Bissau Guinea, The Gambia and Guinea

English (scientific name)	Susu	Creole	Bijago
Oyster ( <i>Grassostrea gasar</i> )	Sibola	Ostra	Ipuén
Razor clams ( <i>Tagellus sp</i> )	Souroungba	Lingron	Ioma
Ark clams ( <i>Arca senilis</i> )	Khombè	Combé	Ebuén Ebent
Volute ( <i>Cymbium spp</i> )	Gnolé	Cuntchurbedja	Edonana
Melongena ( <i>Pugilina morio</i> )	Mandindi	Gandim	Nococon
Rock snails ( <i>Murex</i> )	Mandindi khamè	-	Cantchancari
Cone snails ( <i>Conus</i> )	Tongorony	Fancas	Nogodjo

English (scientific name)	Serer	Wolof	Soce / Mandinka
Oyster ( <i>Grassostrea gasar</i> )	Youkh	Yokhos	Sibola
Razor clams ( <i>Tagellus sp</i> )	-	-	-
Ark clams ( <i>Arca senilis</i> )	Pagn	Pagne	Khombè
Volute ( <i>Cymbium spp</i> )	Djank	Yet	Gnolé
Melongena ( <i>Pugilina morio</i> )	Tuffa	Touffa	Mandindi
Rock snails ( <i>Murex</i> )	Sangaradia	Touffa	-
Cone snails ( <i>Conus</i> )	Khor	Khor	-



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Engineering doctorate in Aquatic Ecology. He has conducted numerous studies and monitoring actions pertaining to marine resource trends in relation to human activities and environmental variability. He has been an independent consultant since 2009.



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# Participatory Monitoring Guide for Shellfish Collected in West Africa

Shellfish have always been an important source of revenue for West African women. In the face of runaway demographics and family needs, pressure on this resource continues to grow. A considerable drop in the production of the different species has been observed, some of which have even become endangered.

To safeguard the role played by shellfish, players in the sector and the authorities continue to pursue avenues and means for improving management policies (preserving the resource and increasing the added value of processed products) within the context of partnerships and exchanges.

By applying the participatory methods that have been developed, the BioCos project (Management of West African Marine and Coastal Biodiversity through Support for Conservation and Monitoring Initiatives in Marine Protected Areas) is a part of this movement toward sustainable shellfish management. This monitoring guide is the fruit of these labours.

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D<sup>R</sup> ALASSANE SARR, NATHALIE CADOT**

