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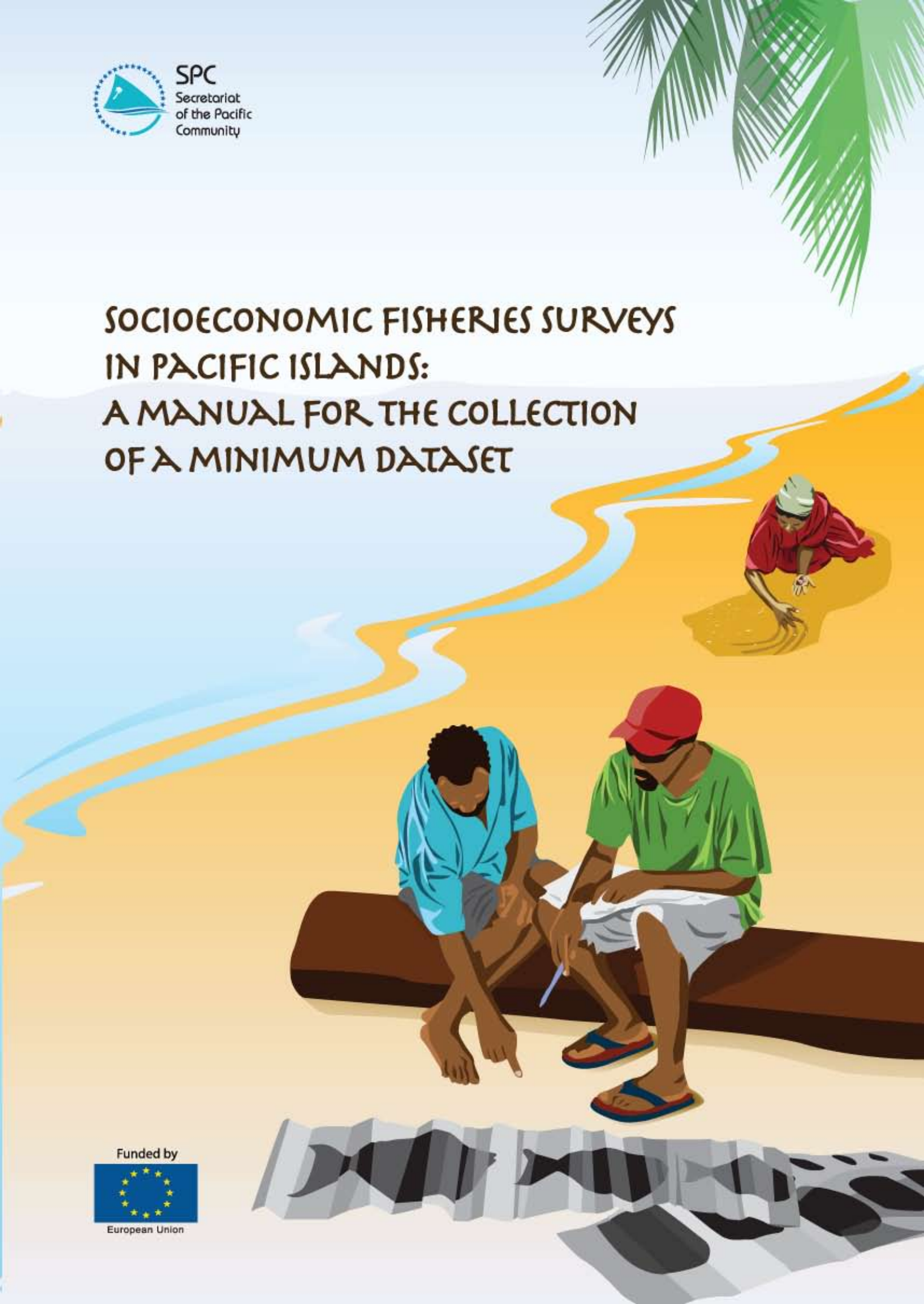
SOCIOECONOMIC FISHERIES SURVEYS IN PACIFIC ISLANDS: A MANUAL FOR THE COLLECTION OF A MINIMUM DATASET



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SOCIOECONOMIC FISHERIES SURVEYS IN PACIFIC ISLANDS: A MANUAL FOR THE COLLECTION OF A MINIMUM DATASET

by

Mecki Kronen, Natasha Stacey, Paula Holland, Franck Magron, Mary Power

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1. INTRODUCTION AND BACKGROUND

1.1 General

There is growing acceptance in the Pacific Islands region that reef and lagoon fisheries can no longer be managed by focusing on the biology of the stocks and the fishing activity alone. Many other aspects of the local community and its use of the resources also have serious implications for the overall health of coastal marine systems. These aspects include alternative income sources, living costs, access to boat transport and fishing gear, and marketing infrastructure.

Information on a variety of aspects of a community, such as demography, income, living costs, boat transport, fishing gear, marketing infrastructure, etc., is usually termed "socioeconomic information".

Socioeconomic information provides an understanding of the social, cultural, economic and political characteristics and conditions of people, households, community groups, and institutions.

Socioeconomic information helps fisheries officers and other coastal resource stakeholders to monitor and manage reef and lagoon resources in their country. The information gathered is also important for making informed decisions about the sustainable use of coastal marine resources.

Looking at it from the other side, the (effective) management of coastal resources has equally serious implications for the welfare of the community in terms of food security, income generation, and cultural practices, especially where the fishery is predominantly for subsistence purposes.

Socioeconomic information can help coastal fisheries managers identify potential problems and focus management priorities accordingly. We now know that understanding these aspects of the community is critical for effective resource management.

For example, understanding the extent to which the traditional non-monetary exchange system has been replaced by a Western cash economy reveals the importance of the role of fishery resources in maintaining social institutions and thus contributing to social security within a community. Such aspects need to be taken into consideration, for example, when planning to improve income-earning opportunities through improving the marketing infrastructure for coastal fishery products.

This manual is a guide on how to collect and analyse "socioeconomic" data on reef and lagoon fisheries.

1.2 Why collect socioeconomic information for reef and lagoon fisheries management?

Socioeconomic assessments are an important component of inshore fisheries management because they:

- demonstrate the importance and value of reef and lagoon resources to coastal communities;
- help fisheries managers understand the relationship between fisheries stakeholders and fisheries resources; and
- help identify problems, key management issues, and potential management measures.

For example, an understanding of the **true** value of reef and lagoon resources can be used to evaluate the benefits and costs of alternative use of those resources (e.g. commercial rather than subsistence; tourism ventures such as diving, or other development) or the likely impact of any management and conservation measure (e.g. Marine Protected Area).

By using socioeconomic information to identify possible impacts of management decisions on stakeholders, we can improve policy and decision-making to minimise negative outcomes and maximise positive outcomes for local resource owners and fishing communities. For example, a decision to set aside an area for a Marine Protected Area (MPA) might impact on some members of the community more than others, especially if a family or clan has tenure over a particular reef area. By documenting the status of resource use and dependency before the policy is implemented, managers can better determine the likely effects of the MPA.

Similarly, managers can use socioeconomic information to predict the effects of alternative policies on the community. For example, the temporary banning of fishing in a certain area or for certain species should take into consideration not only biological and ecological factors, but also the needs of local fishers for food and income. If a particular fishery is closed during the season of highest demand (such as closure of the lobster fishery in some countries during the Christmas and New Year period), the management intervention is likely to fail.

Socioeconomic information can be used to ensure that the concerns and interests of local communities are taken into account in the management process and to plan and direct education and awareness programmes. By identifying the community or community members who have a vested interest, managers can target their awareness raising activities and also ensure that all stakeholders have opportunities to participate in the resource management process.

Socioeconomic surveys typically ask:

- How much fish is generally prepared for one family meal?
- Where do you go fishing?
- How do you fish?
- How often do you go fishing?
- What species do you want to catch?
- How many fish are caught during a normal fishing trip?
- Do you derive income from fishing (do you sell your catch or part of it)?
- To whom do you sell your fish?
- Where do you sell your catch?

1.3 When do you collect socioeconomic information?

Socioeconomic information can be collected as a single "snap-shot" to provide managers with an overview of conditions in the local community at that point in time and to help them design or better focus some proposed short-term management interventions.

When it is done at the start of a longer-term management programme, a socioeconomic assessment can help the manager understand the community and establish **baseline conditions** for future comparisons.

When collected as part of an **ongoing monitoring programme** rather than a one-time assessment, socioeconomic information can be used to identify trends and changes in community and household demographic and economic characteristics, resource use activities, and people's perceptions of marine and community issues. These can be used to identify threats, problems, solutions and opportunities for better resource management. The baseline information then becomes the basis for an ongoing monitoring programme to support **adaptive management**.

For instance, a socioeconomic monitoring programme can provide data to assess impacts when establishing a MPA in a community's fishing ground. Useful key parameters may include information on changes in fishing activities, consumption of reef fish and invertebrates, and household income and expenditure levels. If changes occur that were neither anticipated nor are desirable, appropriate management interventions can be designed and implemented to counteract them.

In this way, socioeconomic information can be used **to measure the effectiveness** of coastal fisheries management programmes in achieving their goals and objectives.

1.4 Why was this manual developed?

In late 2003—early 2004, SPC conducted a survey of a number of Pacific regional fisheries authorities to determine their views on the information that should be collected in socioeconomic surveys to support reef fisheries management. An overwhelming number of survey participants commented on the urgent need to determine the present patterns and levels of use of coastal marine resources. The results of this survey are presented in Annex I of this manual. These results reflect a growing awareness amongst Pacific Island fisheries authorities of two major problems: firstly, that coastal marine resources may increasingly deteriorate, or become dangerously depleted if current exploitation patterns continue; and secondly, that this would be extremely detrimental to food security, income generation and social stability amongst coastal communities in the Pacific region.

Lack of information and knowledge about the status and use of coastal marine resources, in particular for subsistence and small-scale artisanal fisheries, are considered major constraints to determining what management interventions are needed. This is recognised in the Regional Strategic Plan for Coastal Fisheries Management in Pacific Islands, as endorsed during the third Heads of Fisheries Meeting (Noumea, 2003). A draft of this manual was consequently approved as a useful tool by participants at the Regional Training on Fisheries Management and Statistics Workshop (Nadi, Fiji, November 15–19, 2004).

1.5 Structure of the manual and its objectives

The major objective of this socioeconomic manual is to provide a tool that assists fisheries authorities and others in the Pacific region to obtain data that supports informed management decision-making aimed at sustainable, effective and equitable use of reef and lagoon resources.

This manual provides a guide on how to collect socioeconomic data to characterise the role that reef and lagoon resources play in supporting the livelihood of coastal communities, i.e. by answering the following 10 important questions:

1. What are the major socioeconomic characteristics of the community?

2. How much does the community depend on marine resources for consumption, income, and livelihood?

3. How much is fished by whom?

4. What is harvested and where is the catch taken from?

5. What does the community do with the catch?

6. What is the total catch worth at local market prices?

7. What are the fishing strategies[1] used?

8. What gender issues apply?

9. How does the community keep the fish (preservation and stocks)?

10. What knowledge is there of fisheries management rules (traditional and governmental)?

The manual consists of three main sections:

1. Introduction

2. Methodology

3. Results

In the **Introduction** we provide a brief overview of the rationale, objectives, background, scope and limitations of this manual.

The **Methodology** section contains a description of the steps required to plan, prepare, implement and follow up on the type of socioeconomic survey promoted by this manual.

The **Results** section gives the reasons (*why*), lists the input data and the sources (*where*) to obtain them from, the output (graphs, tables), and an example (*how*) of interpreting these for each of the 10 major questions addressed by the type of socioeconomic survey of subsistence and small-scale artisanal fisheries promoted here.

The annexes contain all questionnaire survey forms, check lists, size charts and other useful information.

In addition, a software programme, ***SEMCoS***, has been developed in tandem with this manual to assist in automatically performing all necessary analyses and producing outputs for the data collected.

As the software is continually being upgraded, the latest version of ***SEMCoS*** can be downloaded from the SPC web site at the following address: http://www.spc.int/coastfish/sections/reef/software.htm

1.6 Who is this manual for?

This manual is intended for use by:

- fisheries managers and their staff,

[1] Fishing strategy is here understood as the combination of technique(s) and means of transport used, choice of time of fishing, average duration of a planned fishing trip, objective of the fishing trip (subsistence, commercial, other non-commercial purposes), possible use of ice to preserve the catch and/or guarantee quality of fishery produce, and the choice of habitat(s) and/or species targeted.

- staff of non-governmental organisations,
- research institutions and universities,
- international and regional organisations, and
- other individuals who are involved in data collection, data analysis and the development, implementation and monitoring of coastal fisheries management strategies or measures.

While this manual was not designed solely for use in the Pacific Islands region, the socioeconomic parameters that are used have been tailored to the needs and conditions particular to this region. The focus here is on subsistence and small-scale artisanal coastal fisheries, which are

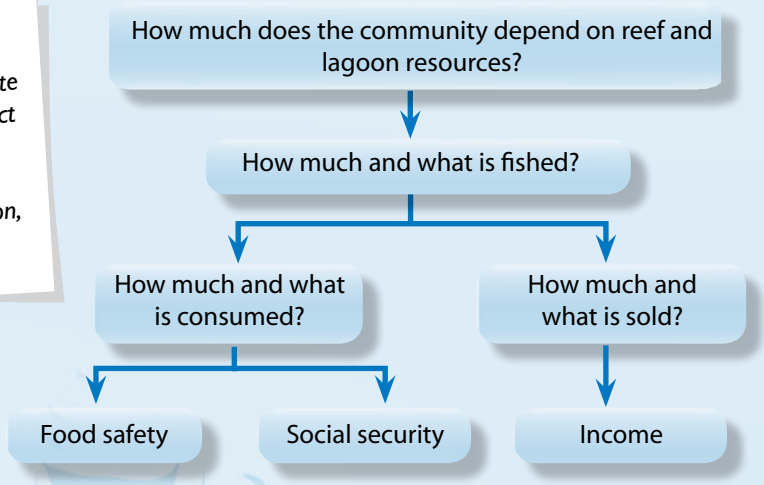
- critical for people's good health and well-being;
- reliable and steady sources of food that act as a buffer against external economic impacts; and
- important for social resilience and stability in coastal rural situations.

1.7 What are the scope and limitations of this manual?

A wide range of methods and approaches[2] are used to conduct socioeconomic assessments, ranging from literature reviews, to informal discussions and interviews, and questionnaire-based surveys and participatory techniques.

This manual focuses on the collection of a **core or minimum set** of socioeconomic data about communities fishing reef and lagoon resources, based on experience gained in the implementation of the Pacific Regional Oceanic and Coastal Fisheries Development/Coastal (PROCFish/C) Programme. It is not intended to be a comprehensive guide to the full range of information that could be collected in coastal communities to facilitate coastal resource management. Rather, it focuses on a subset of this data that will provide a basic understanding of the resource-user dynamic (Figure 1) with least cost and effort.

The fisheries survey component (finfish and invertebrates) aims to estimate the total annual fishing impact that a community has on its resources, and its major reasons (internal consumption, export) for fishing.



The household survey component aims to assess how dependent (food security, social institutions, income) a community is on its coastal fishery resources

Figure 1: Structure of fisheries survey

[2] For more detailed information on other approaches see Bunce, L., Townsley, P., Pomeroy, R. and Pollnac, R. 2000. Socioeconomic Manual for Coral Reef Management. Australian Institute of Marine Science, Townsville.
Mahanty, S. and Stacey, N. 2004. Collaborating for sustainability: A resource kit for facilitators of participatory natural resource management in the Pacific, SPREP, Apia.

The manual covers the use of fully structured questionnaire surveys[3]. This methodology has been shown to be the easiest and most effective in terms of time, and financial and human resource inputs required. In addition:

- it is the method most commonly used by national authorities in the region (national or regional demographic, agricultural or other censuses and surveys); and
- it may be possible to link this household fishery survey, in part or whole, to other national surveys that have to be undertaken regularly (censuses, etc.) for an ongoing monitoring programme with minimum cost-effort implications.

The manual focuses on the use of questionnaires to collect information. The questionnaires involve a simple random sampling of households and fishers.

1.8 What is involved?

Based on our experience within the framework of the PROCFish/C Programme, we have selected the most appropriate sources to obtain the information required. These sources include:

- Interviews with:
  - heads of households, or informed household members;
  - fishers (finfishers, invertebrate fishers, fishers who do both types of fishing);
  - key informants (or senior and informed members of the community);
  - groups of community members (men, women, youth, etc.);
  - agents, middlemen and shop owners;
- Personal observations; and
- Existing information such as reports, statistics, etc.

We first consult any existing information (reports, statistics, etc.) to:

- get a general understanding;
- learn as much as possible about the community; and
- identify data gaps.

We then conduct discussions (using structured and non-structured questionnaires) with **key informants**, and with any members of the community or any person who is well informed about the community and its engagement with reef and lagoon fisheries. These discussions occur preferably at the beginning, but also at any time during the survey when deemed necessary to:

[3] All respondents are asked the same set of questions in the presence of the researcher or field officer; hence we use fully structured questionnaires. By providing a suitable list of possible responses (yes/no; or often, sometimes, never, etc.) we use closed-ended or closed questions. This process produces mainly quantitative data.

- enhance knowledge about the community and its fishing activities;
- obtain information about different user groups;
- learn about commercial issues, marketing channels, etc.; and
- obtain information on any fishery management needs, measures, and compliance.

The implementation of the field survey usually commences with the **household interviews** targeting heads of households or an informed household member.

In addition we interview **fishers**, i.e. individual adult men and women fishers who are members of any of the households that we have covered in the household survey and who target finfish, invertebrates, or both.

We distinguish between finfishers and invertebrate fishers. Often, fishers target both finfish and invertebrates (Figure 2). For methodological reasons, we need to separate the collection of data on finfisheries and invertebrate fisheries.

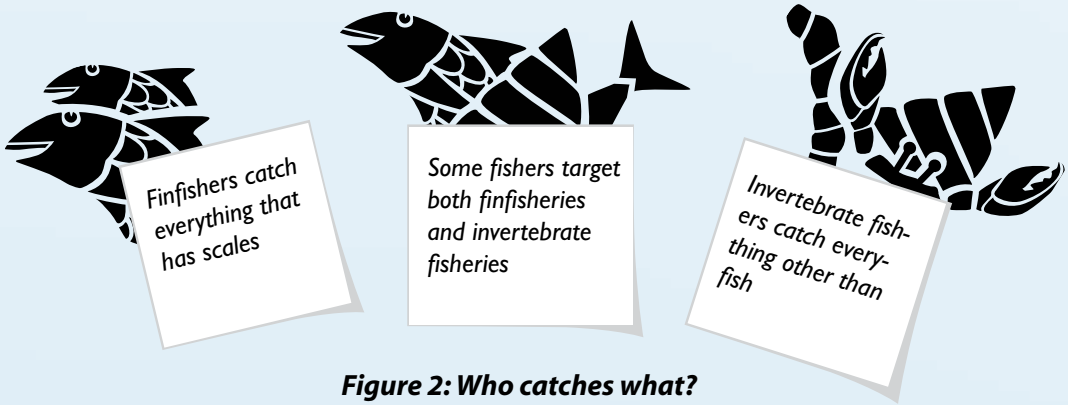


Figure 2: Who catches what?

We may also jointly address **groups in the community** at any time during the field survey.

Where applicable, we interview **middlemen, agents and shop owners** individually to assess the impact (by volume, quality and value) of the commercial use of any coastal fishery product, whether it is used internally (within the community) or exported (national and international).

Personal observations are made throughout the entire field survey, and may be discussed with key informants, individuals or community groups for further clarification.

2. METHODOLOGY

2.1 Managing the survey

The fisheries survey proposed here responds to requests from regional fisheries authorities for assistance in collecting a minimum dataset that best characterises the current and predicted state of reef and lagoon fisheries. The field survey methodology, in particular, the use of questionnaires for interviewing various target groups, is designed accordingly. It is believed that this minimum dataset will allow a qualified analysis of present and possible future developments to identify appropriate fisheries management interventions and/or monitor their effectiveness. In accordance with the needs of regional fisheries authorities, the communities targeted by the proposed survey meet two major criteria:

- they are rural and coastal; and
- they are dependent on coastal fishery resources to some extent, either for food, social security and/or income generation.

The size of the survey is flexible and will depend on objectives, needs and capacities, which should be discussed and clarified by the authority(ies) in charge. Depending on the objective, and the size and scale of the survey to be implemented, the criteria for selecting appropriate sites (communities) have to be defined and applied.

A summary of the six major steps involved in preparing the survey is given below. These steps include:

Step 1: Survey design

Step 2: Background information

Step 3: Additional information

Step 4: Survey management

Step 5: Involving target communities in the survey

Step 6: Field survey materials

The description of these preparatory steps is followed by details of survey sampling and data collection during the field survey (questionnaires, interviews, other information gathering and observations).

STEP 1: Survey design

The first step includes defining the objective of the survey or the questions that the survey will answer. Hence, it also includes nomination of the authority (governmental, non-governmental, research, project, etc.) in charge of, or responsible for the design, implementation and follow-up of the survey. This step covers:

- determination of the survey size (number, location and identification of communities to be surveyed);
- determination and provision of the resources (human, financial, time) needed;

- identification and recruitment of the survey team;
- adoption of the survey approach and methodology; and
- identification and provision of training, materials and other logistical support needed.

Tailoring the survey to match local conditions

Although socioeconomic surveys for fisheries generally focus on a minimum information set, each survey needs to be tailored to specific fisheries, local conditions, and management questions. Specific survey needs might arise, for instance, because of a particular target group or because of the scale of the survey envisaged. Responsibilities and organisational and resource requirements will depend on whether the survey targets a small community or is to be executed at the national level. For example, a one- or two-person team may be able to implement a socioeconomic survey targeting one or several coastal rural communities only. The larger the scale and coverage of a planned survey, the more resources needed.

STEP 2: Background information

After selecting the community(ies), relevant available information, including demographic, social and fisheries statistics, reports, surveys, etc. is reviewed. This step helps to summarise what is already known, thus avoiding duplication of effort, and to identify major gaps. This review may further help to define the questions required to fill in data gaps, and/or the complementary data needed. Preliminary information about the size and structure of a community as well as some knowledge of the degree of its dependence on coastal fishery resources are crucial to effective planning and thus to the success of the survey.

STEP 3: Additional information

Further to a general understanding and background information on the community to be surveyed, there are a number of details required to allow data analysis. This additional information is summarised in the following checklist (Table 1). This checklist needs to be filled in after all background information is collected so as to identify data gaps. It may then be possible to obtain the necessary data and information while on site.

Table 1: Checklist for requirement of additional information

Checklist to identify the need to collect additional information	Information and/or data is available	
	yes	no
Community size and demographics (larger community scale)		
• Total number of households	✓	
• total population number	✓	
• number and type of boats available in the community		✓
Fishing grounds and tenure system		
• marine tenure system known	✓	
• map of fishing ground(s) available[1)]		✓
Size of target community (smaller community scale selected for survey only)		
• total population number (year of census)	✓	
• total number of active households (year of census)	✓	

Checklist to identify the need to collect additional information	Information and/or data is available	
	yes	no
List of fisheries regulations, laws and rules		
• legal	✓	
• community-based		✓
Sale prices at capital city market (shops) for		
• reef and lagoon fish (average price/kg)		✓
• main species of invertebrates (average price/kg)	✓	
• most common sizes of canned fish (average price/fish weight)	✓	
Inventory of vernacular-scientific names		
• reef and lagoon finfish species	✓	
• invertebrate species	✓	
Conversion of local units into corresponding weights in kg		
• reef and lagoon finfish species (major unit(s) used)	✓	
• invertebrate species (list of major units used and conversion to kg)		✓

[1)] Fishing grounds may be owned by the community, a family or a clan, or may be subject to open access tenure. In the latter case, the fishing ground is the area that is usually targeted by the community surveyed.

STEP 4: Survey management

There are a number of tasks that need to be undertaken to ensure that a survey is effectively managed:

- Identifying and assigning tasks to the team;
- Coordinating the work;
- Monitoring quality of data collection and analysis; and
- Organising finances and reporting

Several people have key roles to play in the design, implementation and analysis of a socioeconomic survey:

- Team leader;
- Enumerators (those collecting the data);
- Other support staff (data entry, etc.); and
- Staff responsible for data analysis and reporting

Team members should be familiar with the objectives of the survey, their role in it, and the survey's contribution to resource management. They will need to understand the relationship, importance and content of the entire set of questionnaires to ensure that data collected are relevant, reliable and

accurate. The tasks to be undertaken by each team member should be well defined and agreed on in advance. It is also very important that the survey team members are interested in meeting members of local communities, that they are patient in posing the same questions over and over again, and that they can listen to and engage with local people in an easy and understandable communication process that is free of manipulation.

STEP 5: Involving target communities in the survey

A survey cannot begin or be implemented without the consent and cooperation of the target community(ies). It is advisable to identify in advance how to approach communities, keep them informed, and ensure their ownership of the data. One of the major responsibilities of the team leader is to approach the target communities in the early stages to inform them about the scope and objectives of the survey planned and the reason for selecting the respective community(ies). The team leader must request their agreement to participate and, more importantly, gain their full support for, and engagement in the exercise. The survey team members must also be aware of local customs and cultural protocols and proceed accordingly[4]. The community needs to be fully informed of:

- the reason for and objectives of the survey;
- the contribution required from the community;
- how the data will be collected;
- how the data will be used;
- who will be responsible for data management; and
- in what form and when results and possible recommendations will be returned to the government authorities and community(ies) concerned.

It is important to respect the social rules of the community and know the appropriate behavior and protocols of the target village. Attention may also need to be paid to specific issues concerning gender and ages of different groups. It is recommended that the team leader and the survey team agree on a common strategy for respecting customs, gender (age), and religious issues before starting the survey.

It may be useful to develop a communications plan that outlines the interaction with the community throughout the entire process.

STEP 6: Field survey materials

All questionnaire forms need to be prepared and sufficient copies provided to all enumeration teams. The questionnaire forms suggested in this manual include:

- Household demography and consumption survey questionnaire form (Annex II);
- Finfisher survey questionnaire form (Annex III);
- Invertebrate fisher survey questionnaire form (Annex IV);
- Key informant survey questionnaire form (Annex V);

[4] For general information on the etiquette and protocols of the diverse Pacific Community refer to: SPC, 2005: Cultural etiquette in the Pacific Islands. Noumea, New Caledonia, 147 pp.

- Middlemen, agents, shop owners survey questionnaire form (Annex VI);
- Survey form and summary for additional information to be collected (input required for analysis) (Annex VII); and
- Checklist for requirements for additional information (Table 1).

In addition to the questionnaires, two sets of size charts are provided to help assess the weight of fish and invertebrates caught and consumed. This is necessary as most village fishers do not use kilograms but local units of measure (heaps, plastic bags, strings, baskets, etc.), which are difficult to translate into kilogram weights. Databases such as FishBase[5] allow us to determine the average weight of a fish from its length using already established size-weight relationships. Experience shows that fishers can better estimate the average lengths of the fish species they usually catch rather than making assumptions on their average weight in kilograms. Similarly, efforts are underway to relate diameter, shell length and other size parameters to wet and edible weight for the major invertebrate species. Fish size charts (Annex VIII) and size charts for the major invertebrate groups (Annex IX) are attached to this manual. These size charts make it possible for respondents to communicate average sizes of fishes or invertebrates consumed or caught. All team members must be familiar with using these size charts and any other tools (for instance, aerial photos, prints of satellite images, nautical or other useful charts) to be used for the survey.

The appropriate number of household and fisher survey forms is determined by the size of the community, the sampling method, and sampling size adopted. Usually, only a few key informant, middlemen, agent and shop owner forms are needed for each community to be surveyed. There is usually one checklist and list of additional information needed.

2.2 Selecting the survey sampling technique

Very often it is not possible to survey all households in a given survey area. Thus, it is usually necessary to select a sample of households and/or fishers for surveying. This also means that we will use the values generated for the households and/or fishers surveyed to predict total revenues and catches for the entire population (village or fishery). Consequently, it is important that the sample selected is representative of the overall fisher population, and is not biased in any way. For example, a sample containing mostly households that rely mainly on revenues from sources other than fishing (agriculture, salaries, etc.) would underestimate the catch and effort of the community and its possible impact on fishery resources.

To ensure that samples are representative of the population, households in a survey sample are usually randomly selected to achieve an unbiased sample. The most common random sampling designs are **simple random sampling**, **stratified random sampling**, and **multi-stage random sampling**.

Simple random sampling involves selecting a sample of households from the population entirely at random. (Each household has an equal chance of being selected.) Simple random sampling is most appropriate when the entire population from which the sample is taken is relatively uniform with few differences across the population. Ways to conduct random sampling might include:

- selecting every third house;
- picking household numbers out of a hat; and/or
- selecting the household numbers from a random number table. (Random number tables or manually selected random samples (using dice, cards, etc.) have been replaced by computational random number generators.)

[5] http://www.fishbase.org/home.htm—FishBase a global information system on fishes

Stratified random sampling involves first grouping households into common subgroups or "strata" before selecting random samples from those strata. Stratifying populations is important where there are sub-groups of households in a population that exhibit differences in behaviour and which may bias survey results. For instance, richer households may be able to afford more boats to go fishing than poorer households. If we randomly select the richest households in our survey, the survey results will then be likely to overestimate fishing pressure because richer households will be over-represented and poorer households under-represented.

Houses can be stratified according to common features such as wealth or size. The relative proportion of each stratum in the sample needs to be the same as the relative proportion of each stratum in the overall population to ensure that the samples taken are representative. This means that fewer samples are taken from a small sub-group and more samples are collected to represent relatively larger sub-groups or strata. Once households have been categorised into strata, a random sample is taken from each stratum.

Multi-stage random sampling involves a series of simple random samples that are considered in stages. In a multi-stage random sample, a large area, such as a country, is first divided into smaller regions (such as states), and a random sample of these regions is collected. In the second stage, a random sample of smaller areas (such as villages) is taken from within each of the states chosen in the first stage. In the third stage, a random sample of even smaller areas (such as households) is taken from within each of the areas chosen in the second stage.

2.2.1 Errors and surveys

Because sample surveys involve the use of only selected households to estimate fishing status, there may be differences between the estimated values in a fishery (revenue, catches, etc.) and the true values. These differences are termed sampling errors. Broadly speaking, the more households there are in a sample, the smaller the *sampling errors* are likely to be and the more accurate the estimates of fishery status will be. For example, estimates from strata are likely to have more errors than estimates for the whole of the fishery (because the whole of the fishery would include all samples).

2.2.2 Simple random sampling for socioeconomic field surveys

In this manual, the instructions are aimed at helping to conduct ***simple random sampling***. However, only simple steps are required to make this survey sampling more advanced and to use stratification or multi-stage sampling.

Sample size affects representation. We recommend using a crude but nevertheless practical approach, as shown in Table 2 below. The proportions used will not generate 100 per cent accurate estimates of values for all fisheries. However, they should provide fishery managers with enough useful information to make informed management decisions. It is, however, crucial to ensure that the basic principles of random sampling—regardless of whether random sampling or random stratified sampling are applied—are followed so that the sample does not over- or under-represent the population surveyed.

Table 2: Guideline for determining adequate survey sample size

Population (number of people or number of households)	Sample size
100	25
200	40
300	60
400	60
500	80
1000	100

(Source: Bunce, L. and Pomeroy, B. 2003. Socioeconomic monitoring guidelines for coastal managers in Southeast Asia. SOCMON SEA. GCRMN and World Commission on Protected Areas, NOAA Washington DC, 82 pp.)

2.2.3 Pilot test

The proposed methods, approaches and questionnaires are the result of tests carried out and experience gained within the framework of two long-term projects implemented by SPC's Reef Fishery Observatory[6]. Pilot testing for methods, approach and questionnaires are therefore not obligatory. Pilot testing may, however, be performed so as to familiarise and/or train survey team members, and decide on the most appropriate language, and way of approaching the target community and conducting individual interviews.

It should be borne in mind that the questions provided in the questionnaires are a reminder of what data is needed. The sequence of questions is put into a logical order according to the information requirements prioritised. The sequence and/or way questions are finally formulated and posed may vary according to the situation, the interviewer and the respondent.

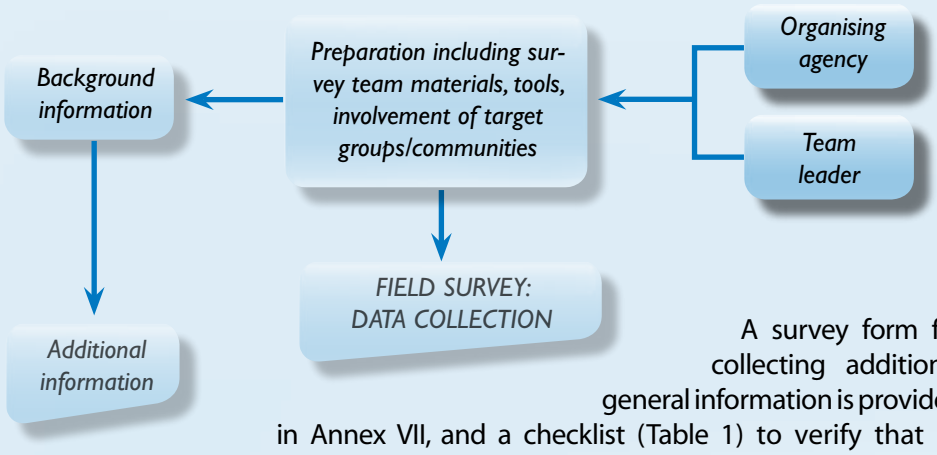
2.3 Field survey—data collection

There are several steps involved in effectively planning and implementing a field survey (Figure 3). Communication with local people is one of the most important prerequisites for success, and so is the use of already available information.

Effective communication requires the involvement of persons who are familiar with, and well accepted by the target community. These people will help to adapt the survey materials and tools to the needs, language and communication requirements of the community(ies) to be surveyed.

Existing information, including demographic data for the target community, is available from a variety of sources including national censuses, statistics, technical and scientific reports and studies. Additional information that is not yet documented but nevertheless essential for data analysis (e.g. prices of seafood produce) may be collected by visiting main market places and shops to collect price information on reef and lagoon fish, major commercialised invertebrates, and canned fish.

Figure 3: Major steps in planning and implementing a field survey and data collection



A survey form for collecting additional general information is provided in Annex VII, and a checklist (Table 1) to verify that all necessary data and information will be made available is provided at the beginning of this section. The team leader should follow up on data gaps identified after filling in the checklist and assign tasks for collecting the missing data accordingly. Most of this missing data should be collected during survey implementation in the respective community(ies).

[6] The DemEcoFish project was funded by the MacArthur Foundation over a two-year period (2001–2003). The project was aimed at developing a design to bring together resource and user reef finfish data using case studies from Tonga and Fiji. Since 2003, the PROCFish/C programme funded by the European Union has attempted to establish a database on the current status and use of reef resources in 17 Pacific Island countries and territories (members of the Pacific Community). It has further tried to identify linkages and relationships between resource status and user level and to develop indicators or proxies that will help fisheries managers to improve fisheries management strategies.

2.4 Field survey—questionnaires

Household and fisher surveys can be conducted using the fully structured, closed questionnaires provided in this manual (Figure 4) (Annexes II to IV). The questionnaires included here correspond to the minimum dataset identified. Answers are structured to obtain quantifiable values that are appropriate for statistical analysis. Households are used as reference units, and information collected from fishers is cross-referenced to the respective household of the fisher interviewed. Thus, fisheries and socioeconomic data can be combined and relationships analysed. In addition, fisheries data collected within the framework of this socioeconomic survey is designed to complement ecological data. Although the socioeconomic survey proposed here is independent, it will produce information that can be analytically linked to resource assessment data that may be gathered additionally or at a later stage.

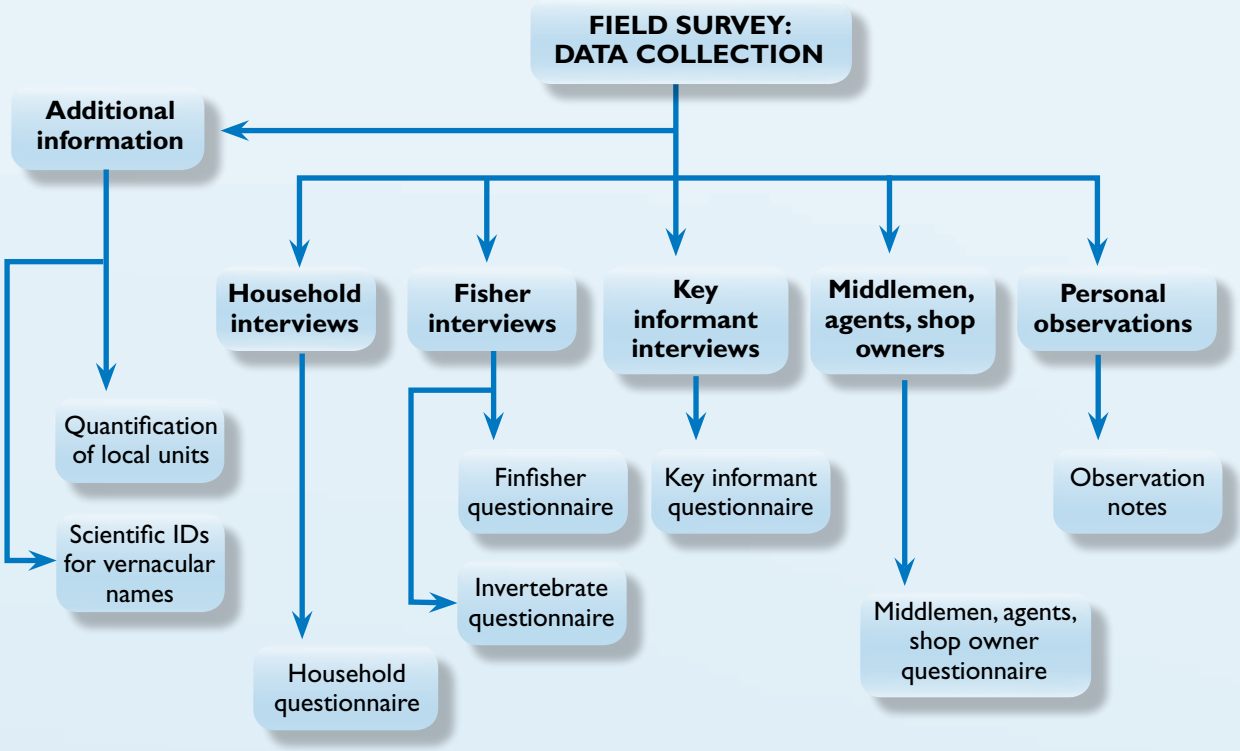


Figure 4: Major elements of a field survey

2.4.1 Household interviews and questionnaire (Annex II)

The major objective of the household survey is to collect up-to-date information on:

- average (active) household size and composition;
- education level of adult members of the household;
- ranked sources of income and average household expenditure level;
- average household consumption patterns and sources; and
- average number of fishers (by gender) and boats per household.

Households are individual units. Members accounted for under each household unit should include only those who permanently reside there, and who continuously participate in household meals. School boarders who return during holidays only, and commuters returning for weekends or visits only, should not be included. It is assumed that the impact of these household members on fishing pressure is negligible.

The survey should target those people in a household who can provide such information. These people may include:

- the head of the household; or
- women in charge of household management; and/or
- women in charge of meal preparation.

2.4.2 Fisher interviews and questionnaires (Annexes III and IV)

The major objective of the fisher survey is to collect detailed information on:

- when, how often and during which months of the year fishers go out to particular habitats;
- average catch size;
- catch composition;
- fishing techniques;
- proportion of the catch targeted for subsistence, gift and sale, and preservation; and
- how finfish and invertebrates are preserved.

Fishers are all people who go fishing regularly, regardless of their gender, objective (subsistence or commercial), target species, transport or techniques used. Fishers include people who target either finfish and invertebrates or both.

The target group is fishers, that is, men and women who are at least 15 years of age and who live in any of the households surveyed. Fisheries interviews should be linked to household interviews so as to avoid double visits. However, people interviewed for fisheries do not have to be the same as those who provide the household information.

Fisheries survey questionnaires are broken down into finfisheries and invertebrate fisheries.

2.4.3 Key informant interviews and questionnaire (Annex V)

The major objectives of the key informant interviews are to learn about:

- the community's fishing grounds;
- management rules (known and applied); and
- major, recurrent problems relating to the use and management of the community's marine resources.

Key informants should also be interviewed to find out the prices for reef and lagoon fish and invertebrates within the community, and to record vernacular names and the seasonality of species.

2.4.4 Middlemen, agent and shop owner interviews and questionnaire (Annex VI)

The major objectives of the middlemen, agent and shop owner interviews are to collect data that enables an estimate of the impact of commercial fisheries activities, including:

- quantities by species or species groups marketed;
- quality and processing level of species marketed;
- price (to buy and sell) in local currency or in USD if international markets are targeted;
- client groups (fishers and consumers); and
- quantitative and qualitative changes in marketing perceived over a period of time.

2.4.5 Additional information: quantification of local units and scientific identifications for vernacular names (Annex VII)

In order to quantify and qualify the fisheries data collected, two major conversion systems are needed. Firstly, local quantitative units (strings, bags, heaps, etc.) must be translated into the metric system (kilograms). Because the average weight of such locally used units may vary significantly from community to community or between market places, the corresponding approximate weight needs to be recorded during each survey and for each community (or market) surveyed. Secondly, it is critical to translate vernacular or local names used by the community(ies) into scientific names. This is particularly important if links are to be made between data collected from users and data collected from resource assessments. Languages and local names may change from one neighbouring village to the other. Thus, scientific species identification must be undertaken in each community surveyed.

An index of vernacular and corresponding scientific names is a necessary requirement for assessing fishing pressure and comparing user and resource data.

2.5 Observation notes

Additional qualitative data can be collected by simply observing behavior and fishing practices (personal observations). This information should complement the overall and specific objectives of the socioeconomic survey. Personal observations may help to highlight important aspects of the communities surveyed, and may also help to better understand the data collected, or the social and cultural contexts of the community and their relationships to resource use. This is particularly true if data analysis is performed by people who have not participated in data collection. However, observation notes should be kept as precise and short as possible and should highlight only those aspects that are crucial to the survey objectives. Such additional explanatory information could include lists of events that may trigger fishing at certain periods, e.g. celebration of the yam harvest, or demand for a specific species such as lobster for Christmas meals.

3. GETTING RESULTS

3.1 Introduction

This chapter describes all the steps needed to enter and analyse data, and to present results. The sections within this chapter reflect the stated needs of fisheries authorities who participated in the "Survey to compile the Household Based Fisheries Survey in South Pacific Island Countries" (Annex I).

Each section in this chapter is introduced by a serious of key issues: the rationale (why), data needed (input data), sources of input data (which questionnaire to use), and outputs expected (tables, charts, analysis).

A sample dataset (for an imaginary country "Pacifica"—comprising the villages of "Tumtata" and "Rumpus" in a region called "Down Islands") is used to provide practical examples of data analysis. Each section is completed with an example of how to interpret the results for fisheries planning and management.

A software programme (***SEMCoS***) has been developed in tandem with this manual to assist in automatically performing all necessary analysis and producing outputs for the data collected. Although the formulas used for data analysis are explained, there are no further explanations given in the following sections on how to produce all the outputs (tables, charts, etc.) suggested. They will be automatically generated by the accompanying software. A ***User Guide*** will be provided with the software package.

SEMCoS is a front-end application to a database. It provides interfaces for data entry and retrieval and generates the outputs described in this manual. The ***SEMCoS User Guide*** gives more details about how to install and operate the software.

The latest version of ***SEMCoS*** and its user guide can be downloaded from the SPC web site at the following address: http://www.spc.int/coastfish/sections/reef/software.htm

The results generated automatically by the software package ***SEMCoS*** are mainly based on average figures. Average figures or means are very useful, but they may not necessarily reflect the pattern within a dataset. It is therefore recommended that users also look at the full range of values within the dataset (minimum and maximum values), the frequency and impact of the different values (median) and the variation of values from the mean (standard deviation, standard error). Further explanations of these simple tests are given in Annex X.

3.2 Data analysis and interpretation

3.2.1 Socioeconomic characteristics

3.2.1.1 Demographic characteristics

WHY? Up-to-date demographic characteristics are often not available. However, total population estimates, average household size, and percentages of adult males and females in the population targeted are necessary to calculate consumption figures. The proportion of adult males and females (all men and women ≥ 15 years of age[1]) are used to estimate total annual catch.

[1] We suggest including only the adult population. Surveying children's participation in fisheries is difficult because of the lack of continuity, and because often the perceptions and objectives of children differ significantly from those of adults. Usually, children accompany their parents and thus their catch and contribution is accounted for by the adult respondent.

INPUT DATA Demographic parameters (number of people, number of households, number and age of men and women)

SOURCE Household demographic and consumption survey (Annex II) / questions: HH1, HH2

OUTPUT Results of this section are summarised in the "demography output table" (Table 3) depicting average figures for household and population data. The adult population is determined by gender.

Table 3: Example "Pacifica": demography output table

Region	Village	Total no. of households surveyed	Total no. of people surveyed	Average household size (no. of people/ household	No. of males %	No. of females %	Per cent males ≥ 15 years	Per cent females ≥ 15 years
Down Islands	Tumtata	15	72	4.8	52.8	47.2	33.3	27.8
Down Islands	Rumpus	15	70	4.7	61.4	38.6	28.6	24.3

Interpretation of example:

Average household sizes in both villages (Tumtata and Rumpus) are comparable. While males and females are equally represented in Tumtata, there is a higher percentage of males in Rumpus. The proportion of adult people in Tumtata is slightly higher than in Rumpus (Table 3).

3.2.1.2 Boat assets

WHY? Boats[2] provide an effective means of measuring fishing effort. More importantly, they provide a useful means of measuring the flexibility that fishers have in choosing fishing grounds. The more boats, and in particular the more motorised boats, the larger the potential range of areas fished. Finally, boats may provide the transport needed to market catches.

INPUT DATA Number of boats (non-motorised and motorised) per household surveyed

SOURCE Household demography and consumption survey (Annex II) / question: HH4

OUTPUT The "boat asset table" gives an overview of the average numbers of boats and boat types per household in the villages surveyed (Table 4).

Table 4: Example "Pacifica": boat asset table

Region	Village	Average no. of total boats/ household	Average no. of canoes/ household	Average no. of sailboats/ household	Average no. of motorised boats/ household
Down Islands	Tumtata	0.67	0.33	0.13	0.20
Down Islands	Rumpus	0.60	0.47	0.00	0.13

[2] The term "boat" is used here to include all types of vessels that facilitate access to fishing grounds and any kind of fishing activity, including rafts, canoes, wooden, fiberglass and aluminium hulls, etc.

3.2.2 Dependence on marine resources—consumption and income

WHY?

Two major parameters are used to describe the dependence of a certain community or population on marine resources. The first is domestic consumption, which provides an insight into the proportion of total nutrition provided by marine resources. The second parameter is income, which shows the degree to which marine resources are used to generate cash revenues. Closely related to these parameters are the sources of marine resources that are consumed and the number of fishers in a population. A high number of fishers in a community may reflect a high dependence on coastal resources, whether for subsistence or for income.

3.2.2.1 Consumption

WHY?

Knowledge of consumption patterns enables planners and managers to assess current protein and nutritive values provided by finfish, invertebrates and canned fish.

INPUT DATA

- People per household by age and gender
- Frequency of reef and lagoon fish consumption in days/week/household
- Quantity of reef and lagoon fish consumed per day in kg/household
- Frequency of canned fish consumption in days/week/household
- Quantity of canned fish consumed per day/household
- Age–gender and frequency correction factors
- Total population figures
- Frequency of invertebrate consumption in days/week/household
- Quantity (number and average size and/or weight in kg) of invertebrates by species consumed per day/household
- Weight index for invertebrates (wet weight, ratio between edible and non-edible parts per unit [piece] of species/species group) (Annex XI).

SOURCE

Household demography and consumption survey (Annex II) / questions: HH6, HH7, HH8

OUTPUT

The major results of this section show the average frequency of consumption for reef and lagoon finfish, invertebrates and canned fish (days/week), total annual consumption (kg/year), and average per capita consumption (kg/year per person). Frequency data is depicted using bar charts, and total and average per capita consumption results are summarised in table format.

Step 1: Calculate annual household consumption of fresh fish, invertebrates and canned fish

All fish quantities should initially be entered directly in kilograms, or as number of fish per fish size class. Then convert these figures to kilograms of finfish consumed per day and per household. To do this, select the relevant formula for fresh and canned fish, respectively, given below. You will see from the formula that we have allowed for two possible weight adjustments during conversion—for non-edible fish parts and one to accommodate standard consumption rates. We recommend a correction factor of 0.8 for the non-edible parts of fish as they account for 20% of total fish weight on average.

The frequency of all consumption data is adjusted downwards by 17% (a factor of 0.83 determined on the basis that about 2 months of a year are not used for fishing due to festivities, funerals, and bad weather conditions) to take into account exceptional periods throughout the year when the supply of fresh fish is limited or when normal fish eating patterns are interrupted (weather conditions, feasts, travel time, etc.). For instance, if the household respondent confirms that they eat fresh fish all year long, we reduce the total number of weeks per year in our multiplication by 17%, i.e. from 52 to 43.16.

Equation for fresh finfish

$$F_{wj} = \sum_{i=1}^{n} (N_{ij} \bullet W_i) \bullet 0.8 \bullet F_{dj} \bullet 52 \bullet 0.83$$

F_{wj}	= *finfish net weight consumption (kg edible meat/household/year) for household$_j$*
n	= *number of size classes*
N_{ij}	= *number of fish of size class$_i$ for household$_j$*
W_i	= *weight (kg) of size class$_i$*
0.8	= *correction factor for non-edible fish parts*
F_{dj}	= *frequency of finfish consumption (days/week) of household$_j$*
52	= *total number of weeks/year*
0.83	= *correction factor for frequency of consumption*

For invertebrates, respondents provide numbers and sizes or weight (kg) per species or species groups usually consumed. Our calculation automatically transfers these data entries per species/species group into wet weight using an index of average wet weight per unit and species/species group (Annex XI)[3].

The total wet weight is then automatically further broken down into edible and non-edible proportions. Because edible and non-edible proportions may vary considerably, this calculation is done for each species/species groups individually (e.g. compare an octopus that consists almost entirely of edible parts with a giant clam that has most of its wet weight captured in its non-edible shell).

[3] The index used here mainly consists of estimated average wet weights and ratios of edible and non-edible parts per species/species groups. At present, SPC's Reef Fisheries Observatory is making efforts to improve this index to enable further specification of wet weight and edible proportion as a function of size per species/species group. The software will be updated and users informed about changes once input data is available.

Equation for invertebrates

$$Inv_{wj} = \sum_{i=1}^{n} E_{Pi} \bullet (N_{ij} \bullet W_{wi}) \bullet F_{dj} \bullet 52 \bullet 0.83$$

Inv_{wj}	= *invertebrate weight consumption (kg edible meat/household/year) of household$_j$*
E_{pi}	= *percentage edible (1=100%) for species/species group$_i$ (Annex XI)*
N_{ij}	= *number of invertebrates for species/species group$_i$ for household$_j$*
n	= *number of species/species group consumed by household$_j$*
W_{wi}	= *wet weight (kg) of unit (piece) for invertebrate species/species group$_i$*
F_{dj}	= *frequency of invertebrate consumption (days/week) for household$_j$*
52	= *total number of weeks/year*
0.83	= *correction factor for consumption frequency*

Equation for canned fish

Canned fish data is entered as total number of cans per can size consumed by the household at a daily meal, i.e.:

$$CF_{wj} = \sum_{i=1}^{n} (N_{cij} \bullet W_{ci}) \bullet F_{dcj} \bullet 52$$

CF_{wj}	= *canned fish weight consumption (kg meat/household/year) of household$_j$*
N_{cij}	= *number of cans for can size$_i$ for household$_j$*
n	= *size of cans (small, medium, large) consumed by household$_j$*
W_{ci}	= *average net weight (kg)/can size$_i$*
F_{dcj}	= *frequency of can consumption (days/week) for household$_j$*
52	= *total number of weeks/year*

Step 2: Calculate average per capita consumption

To determine realistic per capita consumption figures, you will need to take into account gender and age factors in your calculations. Often, a simple division of total household consumption by total number of people is applied. We do not recommend this approximation—although it is widely used—as it will underestimate per head consumption. Without taking into account the age-gender correction, per capita consumption figures calculated for various communities and countries may also not be comparable, particularly if demographic structures vary considerably between the communities being compared. The potential degree of difference when taking, or not taking, age-gender correction factors into account is obvious when considering how much fish a 45-year-old father would eat compared to his 5-year-old daughter. Accordingly, adjustments for consumption need to be made and we promote the use of age-gender correction factors that follow the system established and used by the World Health Organization (WHO).

We apply the following, simple and easy correction factors (Table 5) (Kronen et al. 2006) (see Annex XII for details).

Table 5: Correction system for per capita consumption calculations

Age-gender group	Correction factor
All gender ≤5 years	0.3
All gender 6–11 years	0.6
All males 12–13 years, males 60+ and all females 12+ years	0.8
All males 14–59 years	1.0

You can then determine the per capita finfish, invertebrate and canned fish consumption by selecting the relevant formula from the three provided below:

Finfish per capita consumption

$$F_{pcj} = \frac{F_{wj}}{\sum_{i=1}^{n} AC_{ij} \bullet C_i}$$

F_{pcj} = *finfish net weight consumption (kg edible meat/per capita/year) for household*$_j$
F_{wj} = *finfish net weight consumption (kg edible meat/household/year) for household*$_j$
n = *number of age-gender classes*
AC_{ij} = *number of persons for age class*$_i$ *and household*$_j$
C_i = *correction factor for age-gender class*$_i$

Invertebrate per capita consumption

$$Inv_{pcj} = \frac{Inv_{wj}}{\sum_{i=1}^{n} AC_{ij} \bullet C_i}$$

Inv_{pcj} = *invertebrate weight consumption (kg edible meat/per capita/year) for household*$_j$
Inv_{wj} = *invertebrate weight consumption (kg edible meat/household/year) for household*$_j$
n = *number of age-gender classes*
AC_{ij} = *number of persons for age class*$_i$ *and household*$_j$
C_i = *correction factor for age-gender class*$_i$

Canned fish per capita consumption

$$CF_{pcj} = \frac{CF_{wj}}{\sum_{i=1}^{n} AC_{ij} \bullet C_i}$$

CF_{pcj} = *canned fish net weight consumption (kg meat/per capita/year) for household*$_j$
CF_{wj} = *canned fish net weight consumption (kg meat/household/year) for household*
n = *number of age-gender classes*
AC_{ij} = *number of persons for age class*$_i$ *and household*$_j$
C_i = *correction factor for age-gender class*$_i$

Step 3: Calculate total finfish, invertebrate and canned fish consumption

The total finfish, invertebrate and canned fish consumption of a known population is calculated by extrapolating the average per capita consumption of finfish, invertebrates and canned fish of the sample size to the entire population.

Total finfish consumption

$$F_{tot} = \frac{\sum_{j=1}^{n} F_{wj}}{n_{ss}} \bullet n_{pop}$$

F_{wj} = *finfish net weight consumption (kg edible meat/year) for household$_j$*
n_{ss} = *number of people in sample size*
n_{pop} = *number of people in total population*

Total invertebrate consumption

$$Inv_{tot} = \frac{\sum_{j=1}^{n} Inv_{wj}}{n_{ss}} \bullet n_{pop}$$

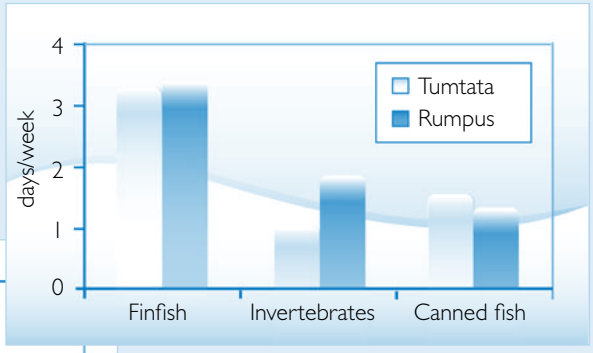
Inv_{wj} = *invertebrate weight consumption (kg edible meat/year) for household$_j$*
n_{ss} = *number of people in sample size*
n_{pop} = *number of people in total population*

Total canned fish consumption

$$CF_{tot} = \frac{\sum_{j=1}^{n} CF_{wj}}{n_{ss}} \bullet n_{pop}$$

CF_{wj} = *canned fish consumption (kg meat/year) for household$_j$*
n_{ss} = *number of people in sample size*
n_{pop} = *number of people in total population*

Figure 5: Example "Pacifica": frequency of seafood consumption



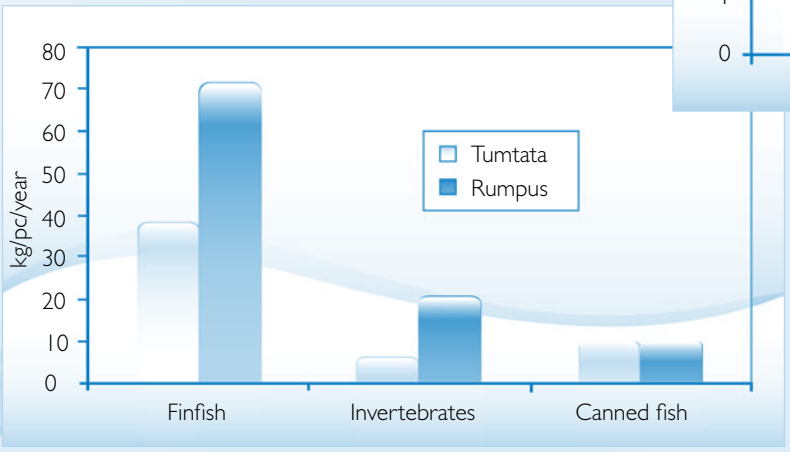


Figure 6: Annual seafood[4] per capita consumption

[4] Edible proportion of invertebrates only.

Table 6: Example "Pacifica": consumption

Region	Village	Total population	Total consumption kg/year			Average per capita consumption kg/year		
			Finfish	Inverte-brates	Canned fish	Finfish	Inverte-brates	Canned fish
Down Islands	Tumtata	265	10,180	1,500	2,527	38.41	5.66	9.54
Down Islands	Rumpus	254	26,319	5,347	2,452	71.82	21.05	9.65

Frequency of seafood consumption is comparable for both villages (Figure 5). Finfish is consumed most frequently (>3 days/week), while invertebrates and canned fish play a less important role. Rumpus people eat invertebrates more often, and Tumtata villagers have canned fish more frequently.

Patterns of seafood quantities consumed vary substantially between communities. The amount of finfish consumed per capita by Rumpus people is almost double the amount eaten by Tumtata villagers (Figure 6). This difference is even more pronounced for invertebrate consumption. The total amount of invertebrate edible parts consumed per capita in Rumpus exceeds that for Tumtata by a factor of 3.7. However, canned fish consumption is comparable (Table 6). Overall, finfish is the most important seafood source for both communities, followed by invertebrates in Rumpus and canned fish in Tumtata.

Compared to average consumption figures listed in Annex XIII for Polynesian or Micronesian countries in the Pacific, fresh fish consumption in Tumtata is rather low, while Rumpus people fall more into a moderate consumer group. Due to the lack of references published, we cannot make such regional comparisons for invertebrate or canned fish consumption. However, if we add the edible per capita consumption figures for people from both communities, the results suggest that Rumpus community members have a very high consumption of seafood proteins with ~93 kg/capita/year (finfish and invertebrates), while Tumtata community members consume much less (~44 kg/capita/year accumulated finfish and invertebrates).

3.2.2.2 Income

WHY? In most cases, knowledge of sources of income is critical in enabling planners and managers to decide whether fisheries or agriculture is more important, and to distinguish between rural (fisheries and agriculture) and more urban (salaries) populations.

We suggest that options of major "other" sources of income in any community surveyed be listed to provide an idea of whether or not "other" sources are mainly accounted for by the artisanal sector (handicrafts, mat weaving, etc.), private business activities (shops, restaurants, transport services, tourism, etc.), or social fees (retirement, family allocation, remittances).

INPUT DATA Sources of income ranked

SOURCE Household demography and consumption survey (Annex II) / question: HH5

OUTPUT The ranked household income source data are summarised, averaged and presented in two different tables (Table 7). We measure the dependence of a community or population on coastal marine resources for generating cash revenues by using a ranked system that compares the importance of four major sources of revenue per each household surveyed, i.e. fisheries, agriculture, salary and others. The proportion (per cent) of first and second ranked sources of income is presented in Table 7.

Table 7: Example "Pacifica": ranking of first and second sources of income for households

Region	Village	First sources of income (%)				
		Total no. of entries = 100%	Fisheries	Agriculture	Salary	Others
Down Islands	Tumtata	29	20.7	20.7	10.3	52.4
Down Islands	Rumpus	27	22.2	18.5	14.8	44.5

Region	Village	Second sources of income (%)				
		Total no. of entries = 100%	Fisheries	Agriculture	Salary	Others
Down Islands	Tumtata	29	13.8	17.3	0	6.9
Down Islands	Rumpus	27	14.8	3.7	0	18.5

These observations are supported by the summary tables above that depict first and second income sources expressed as a per cent of total income (Table 7). These tables also show that primary income from fisheries and agriculture makes up 40% of all income responses, and another 17% when ranked as a second income source. Please note that while some households in Tumtata have more than one first source of income, only 38% and 37% of all households in Tumtata and Rumpus respectively have a second source of income.

3.2.3 Sources of marine resources consumed

WHY?

Information on the sources of marine resources consumed provides additional insight into the socioeconomic structure of a community or population and an indication of how far subsistence needs are covered by genuine fishing effort or food obtained commercially. This is important because it measures the dependence of villagers on coastal resources. For example, the higher the proportion of resources bought, the lower the dependence on coastal resources. This observation may be true for most of the population surveyed; however, it may point to an increased dependence on the few fishers who supply the local market. Note that here we do not take into account food preferences but actual availability.

In this analysis, we also include the proportion of marine resources that is exchanged on a non-monetary basis (gifts). This proportion may be useful to indicate:

- the degree of traditional lifestyle still maintained in a community or population surveyed; and
- the social value of coastal resources.

We assume that the higher the proportion of marine resources exchanged on a non-monetary basis, the more traditional the society and perhaps the more secure and resilient it is. This applies in particular to those households that do not actively participate in any fisheries but benefit through the redistribution system.

INPUT DATA

Ranked sources of finfish and invertebrates consumed

SOURCE

Household demography and consumption survey (Annex II) / questions: HH9, HH10

OUTPUT Frequency data on ranked sources where seafood consumed in the household is expressed in per cent and for both types of seafood, finfish and invertebrates (Table 8).

Table 8: Example "Pacifica": sources of marine resources consumed

8a) Finfish

Region	Village	Sources								
		Caught by household			Received as gift			Bought		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Down Islands	Tumtata	40.7	0	0	3.7	25.9	3.7	11.1	11.1	3.7
Down Islands	Rumpus	21.2	18.2	0	6.1	15.2	12.1	18.2	6.1	3.0

(Note: multiple entries are possible)

We asked respondents to tell us whether finfish and invertebrates that they prepare for their food are mainly caught by somebody from the household, or received from somebody else as a gift, or bought. Usually, seafood is acquired from more than one of these three sources; however, there is a main source complemented by others. Thus, a ranking system has been applied. All answers from all respondents are 100%, and the proportions for each source (caught, received as a gift, bought) are indicated for each village, and separately for finfish and invertebrates. The ranked sources of marine resources consumed (Table 8a and Figure 7) illustrate that in both villages, fish is mainly caught by someone from within the household. Also, finfish is more likely to be bought than received as a gift (Figure 7). Non-monetary exchange of fish is not uncommon, but is more often practised in Tumtata than in Rumpus.

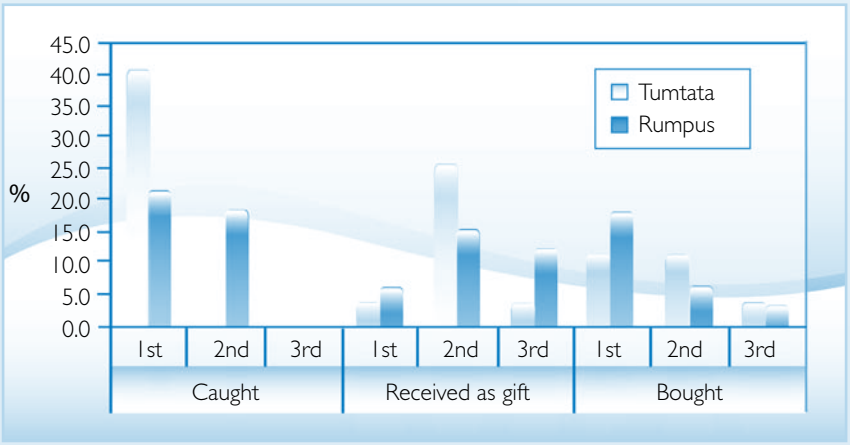


Figure 7: Importance of sources of finfish consumed

8b) Invertebrates

Region	Village	Sources								
		Caught by household			Received as gift			Bought		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Down Islands	Tumtata	73.3	0	0	0	13.3	0	0	13.3	0
Down Islands	Rumpus	75.0	0	0	0	10.0	0	0	5.0	10.0

Figure 8: Importance of sources for invertebrates consumed

Compared to finfish, invertebrates are almost exclusively caught by a household member rather than acquired on a monetary or non-monetary basis (Table 8b). This pattern is very similar in both villages (Figure 8).

In summary, results are similar for both villages. Subsistence fisheries are the most important source of finfish and invertebrates. A lesser share (mainly for finfish) is donated amongst community members. Finfish is occasionally purchased, while invertebrates are rarely bought.

The results suggest high dependence of both communities on marine resources, finfish and invertebrates, for subsistence purposes. The Tumtata community seems to have a slightly more traditional lifestyle because a higher proportion of finfish is exchanged on a non-monetary basis and less finfish is bought. Invertebrate consumption is more subsistence focused than finfish consumption.

3.2.4 Number of fishers

WHY?

The number of fishers in a community or population surveyed assists in determining the dependence on coastal marine resources for subsistence or for commercial purposes. Results enable comparison and assessment of the importance of any or both major fisheries, i.e. finfish and invertebrates. This may help management to prioritise efforts. The proportion of males and females participating in finfisheries, invertebrate fisheries, or both fisheries determines which gender should be targeted by resource managers. The number of fishers by fishery and gender is also an essential input to assessing fishing pressure.

INPUT DATA

- Number of fishers by fisheries, gender and household
- Adult population by gender

SOURCE

- Household demography and consumption survey (Annex II) / question: HH3
- Demography output table

Fishers are distinguished into finfishers, invertebrate fishers and mixed fishers. Mixed fishers fish for both finfish and invertebrates.

OUTPUT

Proportions and numbers of fishers by fishery and gender determined for each village surveyed are depicted in a series of tables, including the total number of fishers, number and percentage of fishers by fisheries, and number of fishers by fisheries and gender output (Table 9). The proportion of adults and fishers in the total population is depicted using a bar chart (Figure 9).

Table 9: Example "Pacifica": fishers (Steps 1 to 3)

Step 1: Determine the total number of fishers in the community and the percentage of fishers in the adult population (≥ 15 years age).

Region	Village	Total no. of adults (≥ 15 years) surveyed	Total no. of fisher identified	Per cent of fishers from total adult population
Down Islands	Tumtata	43	18	41.9
Down Islands	Rumpus	37	19	51.4

Step 2: Determine the total number and percentage of fishers in each fisheries-gender group for the survey sample data.

Village		Total no. of fishers	Invertebrate fishers		Finfishers		Invertebrate & finfishers	
			Male	Female	Male	Female	Male	Female
Tumtata	No.	18	1	5	8	1	2	1
	%	100	5.6	27.8	44.4	5.6	11.1	5.6
Rumpus	No.	19	0	2	6	1	7	3
	%	100	0	10.5	31.6	5.3	36.8	15.8

Step 3: Determine the total number of fishers, and total number of fishers in each fisheries-gender group for the target population, as described in Step 2. This extrapolation is done by applying the percentage of each fisher gender group to the total population of adult males and females in each village.

Village	Total population[1)]	Total no. of adults (≥ 15 years)	Total no. of fishers	Invertebrate fishers		Finfishers		Invertebrate & finfishers	
				Male	Female	Male	Female	Male	Female
Tumtata	265	162	68	4	19	30	4	7	4
Rumpus	254	135	69	0	7	22	4	25	11

[1)] Total population figures as from Table 6, Section 3.2.2.1

The total number of fishers in each village is given as the percentage of fishers from the total adult population in each community, i.e. apply 41.9% and 51.4% for Tumtata and Rumpus respectively (Table 9, Step 1) to the total adult population of 162 and 135 for Tumtata and Rumpus respectively (Table 9, Step 3). The result shows 68 fishers for Tumtata and 69 for Rumpus. The total number of fishers can now be differentiated into the proportion of male and female invertebrate fishers, finfishers, and invertebrate and finfishers applying the percentages shown in Table 9, Step 2.

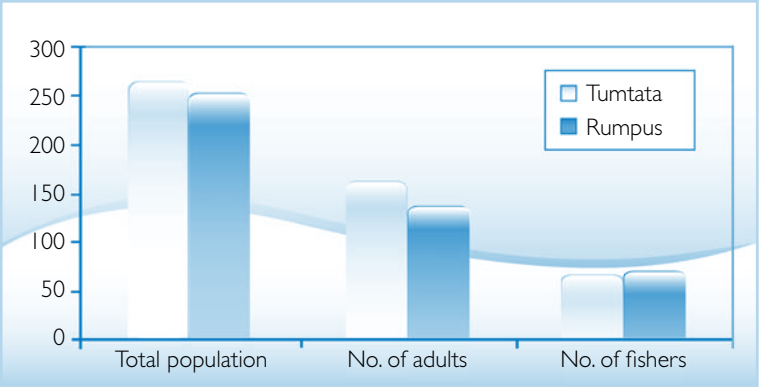


Figure 9: Relation between total population and number of fishers

Results from "Pacifica" indicate that about 1/3 of the adult population in both villages go fishing (Figure 9). In Tumtata, men finfishers and women invertebrate fishers account for most fishers. Rumpus fishers mainly comprise men exclusively targeting finfish. Involvement of women in fisheries is higher in Tumtata than in Rumpus. Gender roles determine that women target more invertebrates and men more finfish in Tumtata; in Rumpus, both finfish and invertebrate fisheries are dominated by men (Table 9, Steps 1–3).

3.3 How much is taken by whom?

WHY?

The magnitude of the population's total annual catch is the measurable impact on the resource and is therefore significant for any coastal fisheries planner or manager.

Subsistence and small-scale fisheries are variable in nature and fishing effort may not necessarily aim at maximising catch. Thus, quantification of catch suffers from the difficulty of characterising "the average catch" which is, however, the required input from fishers interviewed. In order to improve approximation of total annual catch and proportions by gender groups, correction factors have been developed to even out significant sources of overestimation.

INPUT DATA

- Total number of male finfishers and invertebrate fishers
- Total number of female finfishers and invertebrate fishers
- Average annual catch per male finfisher and invertebrate fisher
- Average annual catch per female finfisher and invertebrate fisher
- Fish catch correction factor
- Wet weight index for invertebrates by species/species groups

The total annual catch is the sum of the annual catch by male and female finfishers in the community surveyed

SOURCE

- Household demography and consumption survey (results from Section 3.2.4, Step 3: number of fishers by fisheries and gender)
- Fishery survey (Annex III) / questions: F2, F3, F8
- Invertebrate fisher survey (Annex IV) / questions: IF1, IF2, IF6, IF7

OUTPUT The total annual catch (kg/year) by gender group is depicted in bar charts (Figure 10a and 10b). These figures are calculated on the basis of average catch performances by gender group displayed in an output table.

Step 1

Finfish: Determine average frequency and catch for each gender group from the survey data. Frequency data is corrected by a factor of 0.83 to reduce the year by 17%, to take into account exceptional situations (weather conditions, feasting periods, travel, etc.) (refer to Section 3.2.2.1 Consumption). The average catch is either recorded in kg, or calculated in kg on the basis of number of fish per fish size class.

Invertebrates: Determine average frequency and catch for each gender group from the survey data. Frequency data is corrected by a factor of 0.83 to reduce the year by 17%, to take into account exceptional situations (weather conditions, feasting periods, travel, etc.). The average catch is either recorded in kilograms, or calculated in kilograms on the basis of the number of invertebrates and the mean wet weight for the vernacular name (which may correspond to one individual species or a group of species) (Annex XI).

Table 10: Example "Pacifica": frequency and average catch by gender

Finfish					
Region	Village	Average frequency of fishing trips men/times/year	Average frequency of fishing trips women/times/year	Average catch men/kg/year	Average catch women/kg/year
Down Islands	Tumtata	78	89	912	1,079
Down Islands	Rumpus	64	67	650	711
Invertebrates					
Region	Village	Average frequency of fishing trips men/times/year	Average frequency of fishing trips women/times/year	Average catch men/kg/wet weight/year	Average catch women/kg/wet weight/year
Down Islands	Tumtata	82	76	1,200	78
Down Islands	Rumpus	58	57	775	58

The first output table (Table 10) shows that in a year, both women and men fishers from Tumtata go fishing more frequently and more successfully than Rumpus fishers. This observation applies to both finfishing and invertebrate collection. Average frequency of fishing trips does not vary substantially between gender groups. Average catches are much lower for both gender groups and fisheries in Rumpus compared to Tumtata (Table 10).

Step 2

Finfish: Determine total annual catch by gender group and for all fishers in the community. To do this, we calculate the total annual catch for each fisher interviewed. The average of total annual catches reported for each habitat targeted by finfishers (=each fishery) and by gender is then multiplied by the

total number of fishers calculated for each habitat (=fishery) targeted and for each gender. Finally, all contributions (total annual catch by gender group and habitat targeted) are summed up. The following calculation, using women fishers as an example, also applies to men fishers (to avoid duplication, we have not repeated the same formulas for the latter).

$$TAC = \sum_{h=1}^{N_h} \frac{Fif_h \bullet Acf_h + Fim_h \bullet Acm_h}{1000}$$

TAC = *total annual catch t/year*
Fif_h = *total number of female fishers for habitat$_h$*
Acf_h = *average annual catch of female fishers (kg/year) for habitat$_h$*
Fim_h = *total number of male fishers for habitat$_h$*
Acm_h = *average annual catch of male fishers (kg/year) for habitat$_h$*
N_h = *number of habitats*

Where

$$Acf_h = \frac{\sum_{i=1}^{If_h} f_i \bullet 52 \bullet 0.83 \bullet \frac{Fm_i}{12} \bullet Cf_i}{If_h} \bullet \frac{\sum_{k=1}^{Rf_h} f_k \bullet 52 \bullet 0.83 \bullet \frac{Fm_k}{12} \bullet Td_k}{\sum_{i=1}^{If_h} f_i \bullet 52 \bullet 0.83 \bullet \frac{Fm_i}{12} \bullet Td_i}$$

If_h = *number of interviews of female fishers for habitat$_h$*
(total numbers of interviews where female fishers provided detailed information for habitat$_h$)
f_i = *frequency of fishing trips (trips/week) as reported in interview$_i$*
Fm_i = *number of months fished (reported on interview$_i$)*
Cf_i = *average catch reported for interview$_i$ (all species)*
Rf_h = *number of targeted habitats as reported by female fishers for habitat$_h$*
(total numbers of interviews where female fishers reported targeting habitat$_h$ but did not necessarily provide detailed information)
f_k = *frequency of fishing trips (trips/week) as reported for habitat$_k$*
Fm_k = *number of months fished for reported habitat$_k$*
Td_k = *time spent fishing on average per trip for interview$_k$*
Td_i = *time spent fishing on average trip for interview$_i$*

(fishers = sum of finfishers and mixed fishers, i.e. finfishers and invertebrate fishers)

Invertebrates: Similarly, we determine the total annual catch by gender group and for the total population. To do this, we calculate the total annual catch by each fisher interviewed. The average of total annual catches reported for each type of invertebrate fishery by gender is then multiplied by the total number of fishers calculated for each type of fishery and gender. The following calculation, using women invertebrate fishers as an example, also applies to men invertebrate fishers (to avoid duplication we have not repeated the same formulas for the latter).

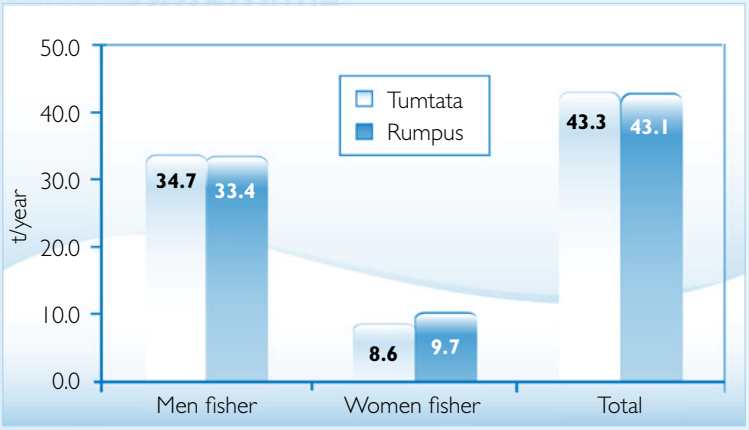
$$TAC_j = \sum_{h=1}^{N_h} \frac{F_{inv}f_h \bullet Ac_{inv}f_{hj} + F_{inv}m_h \bullet Ac_{inv}m_{hj}}{1000}$$

TAC_j = *total annual catch t/year for species$_j$*
$F_{inv}f_h$ = *total number of female invertebrate fishers for habitat$_h$*
$Ac_{inv}f_{hj}$ = *average annual catch of female invertebrate fishers (kg/year) for habitat$_h$ and species$_j$*
$F_{inv}m_h$ = *total number of male invertebrate fishers for habitat$_h$*
$Ac_{inv}m_{hj}$ = *average annual catch of male invertebrate fishers (kg/year) for habitat$_h$ and species$_j$*
N_h = *number of habitats*

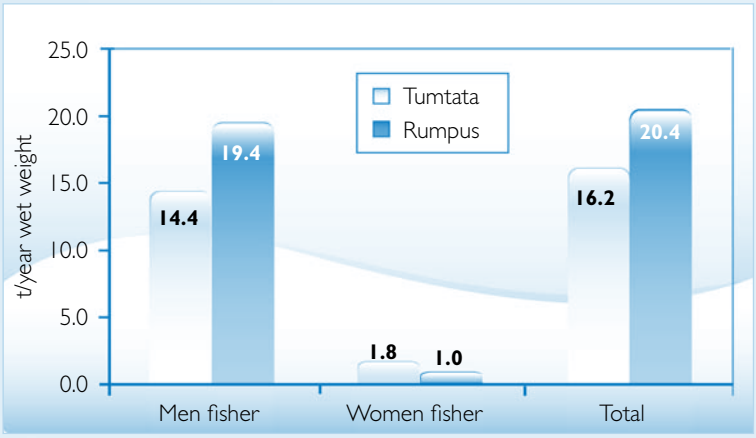
Where

$$Ac_{inv}m_{hj} = \frac{\sum_{i=1}^{I_{inv}f_h} f_i \bullet 52 \bullet 0.83 \bullet \frac{Fm_i}{12} \bullet Cf_{ij}}{I_{inv}f_h} \bullet \frac{\sum_{k=1}^{R_{inv}f_h} f_k \bullet 52 \bullet 0.83 \bullet \frac{Fm_k}{12} \bullet Td_k}{\sum_{i=1}^{I_{inv}f_h} f_i \bullet 52 \bullet 0.83 \bullet \frac{Fm_i}{12} \bullet Td_i}$$

$I_{inv}f_h$ = *number of interviews of invertebrate female fishers for habitat$_h$ (total numbers of interviews where female invertebrate fishers provided detailed information for habitat$_h$)*
f_i = *frequency of fishing trips (trips/week) as reported in interview$_i$*
Fm_i = *number of months fished (reported in interview$_i$)*
Cf_{ij} = *average catch reported for interview$_i$ and species$_j$*
$R_{inv}f_h$ = *number of targeted habitats reported by invertebrate female fishers for habitat$_h$ (total numbers of interviews where female invertebrate fishers reported targeting habitat$_h$ but did not necessarily provide detailed information)*
f_k = *frequency of fishing trips (trips/week) as reported for habitat$_k$*
Fm_k = *number of months fished for reported habitat$_k$*
Td_k = *time spent fishing on average per trip for interview$_k$*
Td_i = *time spent fishing on average trip for interview$_i$*



10a) Finfish



10b) Invertebrates

Figure 10: Total annual catch by gender group

The bar charts in Figure 10 reflect the extrapolated average catch rates of fishers in each community for finfishers and invertebrate fishers (total numbers of fishers include fishers who exploit both fisheries). Finfish production figures for both communities are similar in relation to total annual catch volume, proportions and volume caught by men and women fishers. The same observation largely applies to invertebrate production. However, Figure 10b shows slightly higher productivity, particularly for fishermen from Rumpus village. For figures on total annual catch by gender and habitat, refer to Section 3.4

We can conclude that, overall, the impact of both communities on fisheries resources is similar. However, fishing patterns are different. In Tumtata, fewer fishers fish more often and more successfully. This is particularly true for women finfishers and men invertebrate fishers. In Rumpus, the higher number of fishers is compensated for by less frequent and lower catch rates for both gender groups and both fisheries.

3.4 What is harvested and where is it taken from?

WHY?

Although not exhaustive, parameters such as species diversity, size frequency, and individual species mostly caught are useful in assessing the status of coastal resources targeted. We assume that there is a relationship between the number of species caught, and the diversity of species present in the fishing grounds. We also assume that the bigger the overall fish sizes caught, the less impact previous fishing pressure has had on the stock. Signs of existing stress may be detectable by using data on catch size distribution of particular species considered as indicators.

The total annual catch per species group is a useful indicator of whether or not fishing pressure is evenly distributed or targets selected species only.

Determining fishing pressure in terms of total annual catch for each habitat or fishery assists in identifying areas with higher and lower fishing pressure.

To some extent, the utility of assessments depends on the availability of time series. However, any assessment will be useful to establish a baseline dataset for future comparison.

Generally, information gathered from fishers is based on the vernacular name system. In many countries, there are lists of vernacular and scientific names. However, there may be several local (vernacular) terms for the same species, making it difficult to design and use an exhaustive index.

Here, it is important to use the vernacular-scientific list that has been supplemented during field survey implementation so that local names can be included (refer to Section 2.4.5 Additional information: quantification of local units and scientific identifications for vernacular names; Annex VII).

INPUT DATA

- Fish and invertebrate species consumed and caught
- Size distribution of fish and invertebrates caught
- Species diversity
- List of vernacular-scientific names for finfish and invertebrates
- Frequency of trips
- Mean wet weight for invertebrates by vernacular name
- Total number of households at the site (for extrapolation)

SOURCE

- Finfisher and invertebrate fisher surveys (Annexes III, IV)
- Key informant—selected information (Annex V)
- Survey and/or general information (Annex VII)—Checklist (Table 1)
- Questions: F3, F9, IF4, IF5, IF6, IF7; vernacular-scientific names—reef and lagoon fish
- List of mean wet weight of invertebrates (Annex XI)

OUTPUT

The output of this section is presented in bar charts and tables. Tables include the species diversity index for finfish and invertebrates, frequency of species quoted for finfish and invertebrates, and frequency of finfish sizes caught and by species. In addition, the frequency of finfish sizes caught, and the species-finfish and invertebrate frequency size distribution per village surveyed, are presented in bar chart format.

By calculating the total number of finfish by size class and by species, and by applying the FishBase weight-length relationships, we can estimate the total annual catch by weight (kg) and break this figure down by species and by habitat.

Similarly, we use the total number of invertebrates for each species and species groups to estimate the total annual catch by weight and by fishery in applying average weight (wet weight and edible proportions as provided in Annex XI) for each species or species group.

The total annual impact per species group for finfish and invertebrates is provided in table format, as are accumulated total annual catch figures for each habitat (finfishing) and fishery (invertebrate fishery).

Table 11: Example "Pacifica": catch characteristics

11a) Species diversity (total number of finfish and invertebrate species recorded)

Region	Village	Total no. of finfish species recorded	Total no. of invertebrates recorded
Down Islands	Tumtata	19	22
Down Islands	Rumpus	19	19

11b) Frequency of finfish species recorded

Species / Down Islands	Tumtata		Rumpus	
	Score	%	Score	%
Blackfin	6	5.8	6	5.3
Blackspot	8	7.7	6	5.3
Bluefin	5	4.8	9	7.9
Bluespot	4	3.8	4	3.5
Brownspot	8	7.7	7	6.1
Greenfin	9	8.7	7	6.1
Greenspot	8	7.7	5	4.4
Longfin	3	2.9	4	3.5
Orangefin	8	7.7	9	7.9
Pinkspot	5	4.8	5	4.4
Purplespot	5	4.8	10	8.8
Redfin	7	6.7	8	7.0
Redspot	8	7.7	8	7.0
Shortfin	1	1.0	1	0.9
Smallfin	2	1.9	4	3.5
Whitefin	3	2.9	5	4.4
Whitespot	8	7.7	8	7.0
Yellowfin	4	3.8	1	0.9
Yellowspot	2	1.9	7	6.1
Total	104	100.0	114	100.0

11c) Frequency(%) of finfish size classes caught

Region	Village	Total no.	Size classes (cm)					
			8 (A)	16 (B)	24 (C)	32 (D)	40 (E)	48 (E+)
Down Islands	Tumtata	777.0	1.4	13.3	26.0	26.1	33.2	0.0
Down Islands	Rumpus	15.5	15.5	43.4	12.7	21.0	7.4	0.0

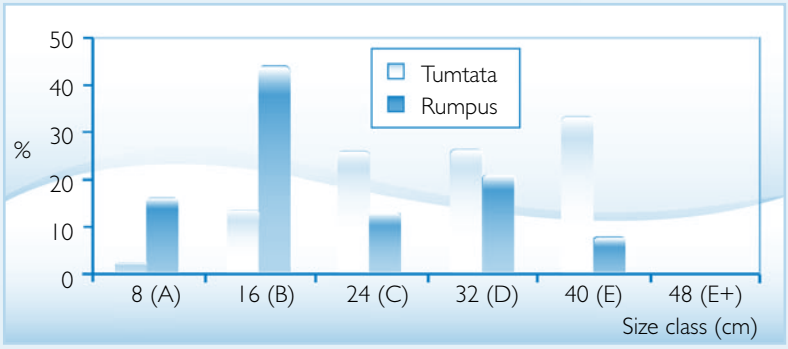


Figure 11: Frequency of finfish size classes caught

11d) Frequency(%) of finfish size class distribution by species—Tumtata

Species	Size classes (cm)					
	8 (A)	16 (B)	24 (C)	32 (D)	40 (E)	Total
Blackfin	0.0	0.8	1.3	1.5	3.9	7.5
Blackspot	0.0	0.5	3.0	2.8	2.1	8.4
Bluefin	0.0	0.0	1.3	0.5	2.1	3.9
Bluespot	0.0	1.0	1.5	0.0	1.7	4.2
Brownspot	0.0	0.5	2.2	2.8	2.2	7.7
Greenfin	0.0	1.7	0.9	2.3	2.6	7.5
Greenspot	1.4	4.4	0.8	3.3	0.0	9.9
Longfin	0.0	0.6	2.3	0.0	0.0	3.0
Orangefin	0.0	0.5	1.2	1.7	1.7	5.0
Pinkspot	0.0	0.0	0.9	1.7	1.7	4.2
Purplespot	0.0	0.0	1.7	1.0	2.8	5.5
Redfin	0.0	0.0	1.5	2.4	3.0	6.9
Redspot	0.0	1.7	1.0	1.5	3.2	7.5
Shortfin	0.0	0.0	0.5	0.0	0.0	0.5
Smallfin	0.0	1.0	0.0	1.3	0.0	2.3
Whitefin	0.0	0.0	1.0	0.0	2.4	3.5
Whitespot	0.0	0.5	3.1	0.5	1.4	5.5
Yellowfin	0.0	0.0	0.0	2.6	1.3	3.9
Yellowspot	0.0	0.0	1.8	0.0	1.3	3.1
Total	1.4	13.3	26.0	26.1	33.2	100.0

11e) Frequency(%) of finfish size class distribution by species—Rumpus

Species	Size classes (cm)					
	8 (A)	16 (B)	24 (C)	32 (D)	40 (E)	Total
Blackfin	0.9	9.9	1.3	1.3	0.0	13.4
Blackspot	1.0	0.7	0.9	1.9	0.1	4.6
Bluefin	1.7	0.8	1.7	1.4	0.8	6.4
Bluespot	1.0	1.7	0.0	0.8	0.8	3.3
Brownspot	0.8	2.8	0.9	0.9	0.7	6.1
Greenfin	1.8	0.7	1.2	0.5	1.8	6.0
Greenspot	0.0	1.3	0.8	1.6	0.0	3.7
Longfin	0.0	1.9	0.0	1.0	0.7	3.6
Orangefin	2.3	2.0	1.2	1.4	0.0	6.9
Pinkspot	0.0	1.8	0.4	1.2	0.1	3.5
Purplespot	0.9	6.7	0.0	0.0	0.1	7.7
Redfin	0.9	2.1	0.0	1.5	2.0	6.5
Redspot	1.7	1.7	0.4	1.7	0.3	5.8
Shortfin	0.0	0.0	0.8	0.0	0.0	0.8
Smallfin	0.0	1.2	1.0	1.7	0.0	3.9
Whitefin	0.0	3.8	0.0	0.9	0.0	4.7
Whitespot	2.7	1.4	0.9	1.2	0.0	6.2
Yellowfin	0.0	1.3	0.0	0.0	0.0	1.3
Yellowspot	0.8	1.6	1.2	2.0	0.0	5.6
Total	15.5	43.4	12.7	21.0	7.4	100.0

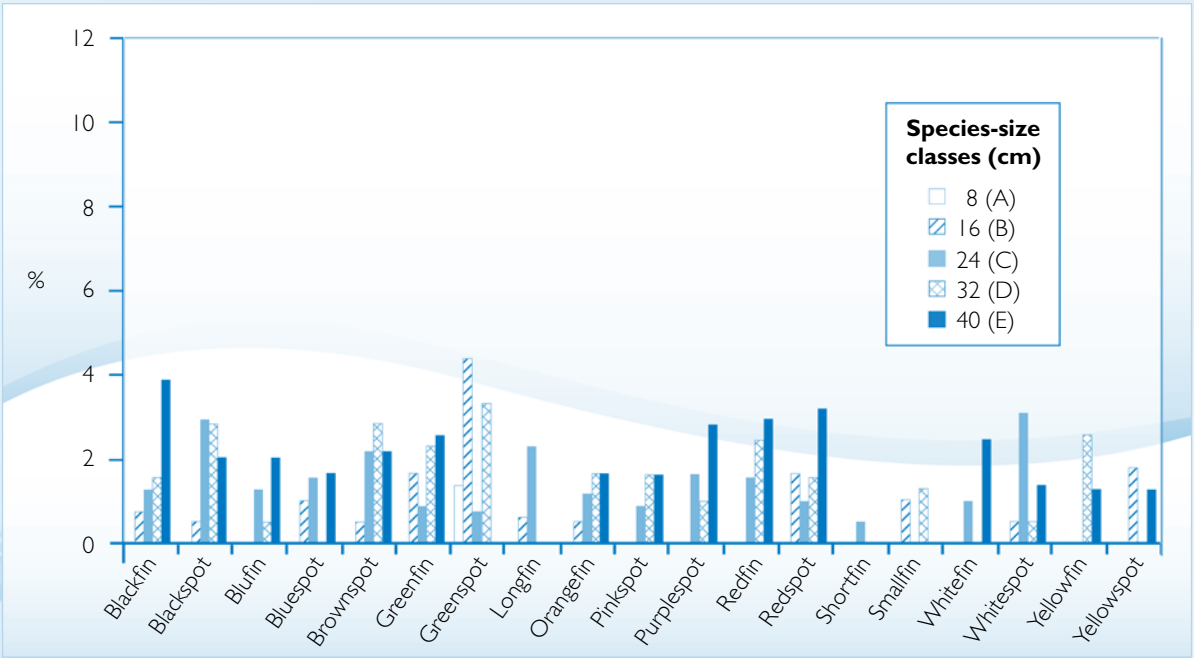


Figure 12: Species-frequency size distribution—Tumtata

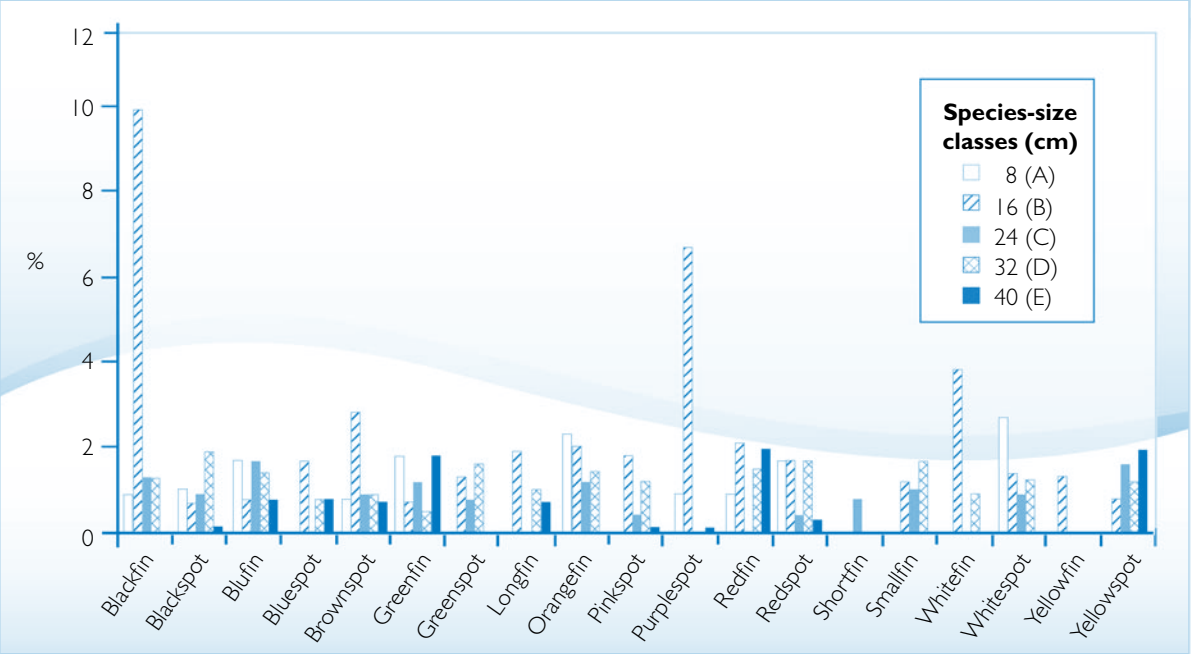


Figure 13: Species-frequency size distribution—Rumpus

11f) Frequency of invertebrate species recorded

Species / Down Islands	Tumtata		Rumpus	
	Score	%	Score	%
BdM1	1	2.3	1	2.2
BdM2	1	2.3	1	2.2
BdM3	1	2.3	1	2.2
BdM4	1	2.3	1	2.2
Clam 1	2	4.5	1	2.2
Clam2	2	4.5	1	2.2
Crab-A	3	6.8	3	6.7
Crab-B	3	6.8	3	6.7
Crab-C	3	6.8	3	6.7
Crab-X	1	2.3	0	0.0
Lobster	2	4.5	2	4.4
Octopus	3	6.8	4	8.9
Shell-A	3	6.8	4	8.9
Shell-B	3	6.8	4	8.9
Shell-C	3	6.8	4	8.9
Shell-D	2	4.5	2	4.4
Shell-E	2	4.5	2	4.4

Down Islands / Species	Tumtata		Rumpus	
	Score	%	Score	%
Shell-F	2	4.5	2	4.4
Trochus	1	2.3	2	4.4
Urchin-A	3	6.8	4	8.9
Seaweed-A	1	2.3	0	0.0
Total	44	100.0	45	100.0

Table 11g: Frequency-size distribution (% of recorded numbers) of crab catches in Tumtata (T) and Rumpus (R)

Village	Species	>8–10 cm	>10–12 cm	>12–14 cm
Tumtata	Crab-A-T	0	0	100
	Crab-B-T	100	0	0
	Crab-C-T	0	0	100
	Crab-X-T	0	100	0
Rumpus	Crab-A-R	0	0	100
	Crab-B-R	100	0	0
	Crab-C-R	0	0	100

Table 11h: Frequency-size distribution (% of recorded numbers) of shell catches in Tumtata (T) and Rumpus (R)

Village	Species	0–2 cm	>2–4 cm	>4–6 cm	>6–8cm	>8–10 cm
Tumtata	Shell-A-T	0	0	50	50	0
	Shell-B-T	0	0	30	70	0
	Shell-C-T	0	0	0	0	100
	Shell-D-T	40	60	0	0	0
	Shell-E-T	0	100	0	0	0
	Shell-F-T	100	0	0	0	0
Rumpus	Shell-A-R	0	0	65	35	0
	Shell-B-R	0	0	25	75	0
	Shell-C-R	0	0	0	0	100
	Shell-D-R	0	100	0	0	0
	Shell-E-R	100	0	0	0	0
	Shell-F-R	100	0	0	0	0

Table 11i: Frequency-size distribution (% of recorded numbers) of bêche-de-mer, lobster and clam catches in Tumtata (T) and Rumpus (R)

Village	Species	>16–18 cm	>18–20 cm	>20–22 cm	>22–24 cm	>24–26 cm	>26–28 cm	>28–30 cm
Tumtata	BdM1-T	0	100	0	0	0	0	0
	BdM2-T	0	0	0	0	0	0	100
	BdM3-T	0	0	0	0	100	0	0
	BdM4-T	0	0	0	100	0	0	0
	Clam 1-T	45	0	55	0	0	0	0
	Clam 2-T	40	60	0	0	0	0	0
	Lobster-T	0	0	0	0	70	30	0
Rumpus	BdM1-R	0	100	0	0	0	0	0
	BdM2-R	0	0	0	0	0	0	100
	BdM3-R	0	0	0	0	100	0	0
	Clam 1-R	0	0	0	0	100	0	0
	Clam 2-R	0	0	0	100	0	0	0
	Lobster-R	0	0	0	0	15	85	0

Table 11j: Frequency-size distribution (% of recorded numbers) of urchin, octopus and trochus catches in Tumtata (T) and Rumpus (R)

Village	Species	>8–10 cm	>10–12 cm	>12–14 cm	>14–16 cm
Tumtata	Urchin-A-T	0	100	0	0
	Octopus-T	95	5	0	0
	Trochus-T	0	100	0	0
Rumpus	Urchin-A-R	0	100	0	0
	Octopus-R	70	10	20	0
	Trochus-R	0	0	65	35

Table 11k: Extrapolated total annual catch[1)] per vernacular finfish species group and per village

Species / Down Islands	Tumtata		Rumpus	
	%	Kg	%	Kg
Blackfin	6.6	2,856	7.8	3,345
Blackspot	6.1	2,654	6.4	2,765
Bluefin	7.4	3,219	6.7	2,871
Bluespot	4.6	1,987	4.2	1,834
Brownspot	5.6	2,435	5.4	2,333
Greenfin	9.0	3,879	7.3	3,137
Greenspot	6.7	2,879	5.1	2,198

Down Islands / Species	Tumtata		Rumpus	
	%	Kg	%	Kg
Longfin	5.4	2,345	3.4	1,482
Orangefin	6.4	2,765	6.9	2,969
Pinkspot	4.6	1,987	2.9	1,239
Purplespot	4.9	2,134	7.5	3,222
Redfin	5.9	2,543	6.7	2,876
Redspot	4.3	1,879	6.5	2,799
Shortfin	3.9	1,681	1.7	743
Smallfin	2.1	912	4.5	1,922
Whitefin	3.3	1,435	3.6	1,548
Whitespot	6.7	2,912	5.6	2,430
Yellowfin	4.2	1,839	2.9	1,244
Yellowspot	2.2	943	5.1	2,199
Total	100.0	43,284	100.0	43,156

[1)] The total annual catch figures (as presented in Table 10, Section 3.3 How much is taken by whom?) are here broken down by species. The total annual catch per species is its percentage of the total reported annual catch.

Table 11l: Extrapolated total annual finfish catch[1)] per habitat fished and per village

Down Islands / Habitat	Tumtata		Rumpus	
	Kg/year/all men fishers	Kg/year/all women fishers	Kg/year/all men fishers	Kg/year/all women fishers
Coastal	27,032	3,581	20,044	5,850
Lagoon	7,624	3,581	8,352	3,900
Outer reef	0	1,467	5,011	0
Total	34,656	8,628	33,407	9,750

[1)] Total annual catch figures (as presented in Table 10, Section 3.3 How much is taken by whom?) are here broken down by habitat fished.

Table 11m: Extrapolated total annual catch[1)] per vernacular invertebrate species group and per village

Down Islands / Species	Tumtata		Rumpus	
	% of total catch	Kg	% of total catch	Kg
Bêche-de-mer 1	5.0	1,053	7.3	1,382
Bêche-de-mer 2	5.0	1,053	6.5	1,230
Bêche-de-mer 3	5.0	1,053	7.5	1,420
Bêche-de-mer 4	3.0	632	6.8	1,287
Clam 1	2.5	526	2.2	416
Clam 2	2.5	526	6.5	1,230

Down Islands / Species	Tumtata		Rumpus	
	% of total catch	Kg	% of total catch	Kg
Crab-A	2.5	526	2.4	454
Crab-B	3.0	632	2.8	530
Crab-C	3.0	632	3.2	606
Crab-X	5.0	1,053	0.0	0
Lobster	7.5	1,579	7.5	1,420
Octopus	7.5	1,579	7.5	1,420
Shell-A	6.8	1,432	6.8	1,287
Shell-B	2.2	463	2.2	416
Shell-C	6.5	1,369	6.8	1,287
Shell-D	2.0	421	2.2	416
Shell-E	5.0	1,053	6.5	1,230
Shell-F	6.0	1,264	6.2	1,173
Trochus	3.5	737	2.6	492
Urchin-A	6.5	1,369	6.5	1,230
Seaweed-A	5.0	1,053	0.0	0
Seaweed-B	5.0	1,053	0.0	0
Total	100.0	21,059	100.0	18,927

[1)] Total annual catch figures (as presented in Table 10, Section 3.3 How much is taken by whom?) are here broken down by species. The total annual catch per species is its percentage of the total reported annual catch.

Table 11n: Extrapolated total annual invertebrate catch[1)] per fishery and per village

Down Islands / Fishery	Tumtata		Rumpus	
	Kg/year/ all men fishers	Kg/year/all women fishers	Kg/year/ all men fishers	Kg/year/all women fishers
Reef top gleaning	2,160	269	1,937	208
Soft benthos gleaning	0	896	968	260
Mangrove gleaning	2,449	359	2,905	312
Lobster diving	4,321	0	3,874	0
Bêche-de-mer	5,041	269	4,842	260
Trochus	432	0	4,842	0
Total	14,403	1,793	19,369	1,039

Reef top gleaning: clam 1, clam 2, shell-A to shell-C, crab-A, crab-B, octopus, urchin-A. Soft benthos gleaning: shell-D to shell-F, seaweed-A, seaweed-B. Mangrove gleaning: crab-C, crab-X. Lobster diving: lobster. Bêche-de-mer: bêche-de-mer 1 to 4. Trochus: trochus.

[1)] The total annual catch figures (as presented in Table 10, Section 3.3, How much is taken by whom?) are here broken down by fishery.

The diversity of finfish and invertebrate species caught is similar when comparing both villages (Table 11a). However volume varies, with bluefin, purplespot and yellowspot significantly more represented in Rumpus, and greenspot and yellowfin more in Tumtata (Table 11b). Major differences are found if comparing frequency of finfish size classes caught (Table 11c). Catches in Tumtata are characterised by size classes 16–40 cm, while Rumpus fishers catch predominantly 8–16 cm and 24–32 cm long fishes (Figure 11). Smallest fish sizes (0–8 cm) are rarely caught in Tumtata. As would be expected, these differences also show in the frequency of size distribution by species. While size distribution frequency is equally spread between all species caught in Tumtata, two species in Rumpus, blackfin and purplespot, show extremely high proportions in the 8–16 cm length class (Tables 11d & 11e). Otherwise, size class distribution frequency is balanced over all other species in Rumpus (Figures 12 & 13).

Size distribution and frequency of sizes caught are comparable for crabs (Table 11g), bêche-de-mer, lobster, clams, octopus and urchins (Tables 11f & 11i). Differences occur for shells (Table 11h) and trochus (Table 11j) with smaller species caught in Rumpus than in Tumtata.

Results suggest that both communities have access to ecologically comparable fishing grounds, and therefore similar species diversity. However, using catch characteristics as parameters, fishing pressure seems to differ, with no apparent impact in Tumtata but an impact on size classes and certain species in Rumpus, such as shells and trochus in the case of invertebrates. Fish caught in Rumpus are generally not only smaller, but also show an uneven size distribution frequency, which may point towards fishing impact on certain fish sizes and species.

These findings can also be demonstrated by extrapolating our survey data to the total fisher population in both villages. Although extrapolation only allows an estimated assessment of the total annual impact, the emerging trends suggest that:

a) generally, total impact on finfisheries is comparable in both fishing grounds of either village (Table 11k);

b) differences are found when we compare total annual catch by species (Table 11k) and by habitat (Table 11l). In Tumtata, fishing pressure on coastal finfish resources is higher than in Rumpus and the opposite is true for the outer reef.

The extrapolation of invertebrate catches shows that while total annual impact is slightly higher in Rumpus than in Tumtata (Table 11m), fishing pressure seems to be similarly distributed amongst the resources of both villages. However, there is no seaweed and crab-X exploitation in Rumpus. Comparison of fishing pressure by fisheries shows that there is high pressure on trochus in Rumpus, while in Tumtata lobsters seem to be under higher pressure (Table 11n).

3.5 What does the community do with the catch?

WHY? Knowledge on the proportions of catch used for subsistence, social purposes and generating income helps to understand not only the motivation of fishers, but also to assess the potential dynamics and future development of the community's fisheries. Fisheries managers may use this information to assess interventions aimed at food security and/or control of commercial exploitation.

We focus here on the commercial proportion of the catch that is exported out of the community, i.e. the share of finfish caught by the community but not consumed, used or sold within the community. Including marketing details provides further insight on where and to whom fish is sold and gives a better understanding of existing marketing structures.

INPUT DATA

- Total annual catch (result from 3.4)
- Total annual consumption (result from 3.2.2)
- Markets and clients supplied commercially
- Finfisher survey (results from 3.4)
- Household demography and consumption survey (results from 3.2.2)

SOURCE

- Finfisher and invertebrate fisher surveys / questions: F10, F11, IF6, IF7

OUTPUT

There are three output tables: finfish export, market place (finfish and invertebrates), and clients (finfish and invertebrates). The balance between total annual catch, consumption and export is shown in bar charts for each village surveyed.

The total annual export (t/year) from the community is the balance between total annual catch (Section 3.4) and total annual consumption (Section 3.2.2), i.e.:

$$E = TAC - \left(\frac{F_{tot}}{1000} \bullet \frac{1}{0.8}\right)$$

E = *total annual export (t)*
TAC = *total annual catch (t)*
F_{tot} = *total annual finfish consumption (net weight kg)*
$\frac{1}{0.8}$ = *to calculate total biomass/weight, i.e. compensate for the earlier deduction by 0.8 to determine edible weight parts only*

Table 12: Example "Pacifica": total annual finfish export

Region	Village	Total finfish catch (t/year)	Total finfish consumption (t/year)	Total finfish export (t/year)
Down Islands	Tumtata	43.3	10.2	33.1
Down Islands	Rumpus	43.2	26.3	16.9

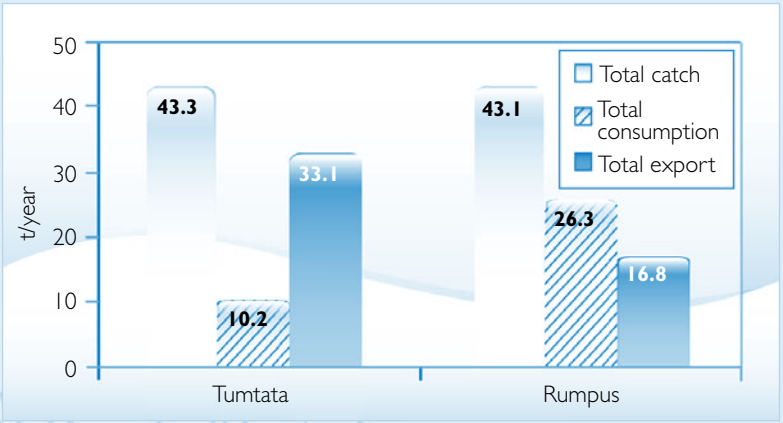


Figure 14: Example "Pacifica": balance between total annual finfish catch, consumption and export

The above table (Table 12) and bar chart (Figure 14) illustrate the differences between both villages in the proportion of total annual catch consumed and exported outside the community. Tumtata people eat less and export most of their catch, while Rumpus people eat more and export less (Table 12).

Table 13: Example "Pacifica" —market place

Region	Village	Sold to (%) (multiple entries possible)			
		Inside community	External	Inside community	External
		Finfish		Invertebrates	
Down Islands	Tumtata	33	100	0	100
Down Islands	Rumpus	44	100	0	100

Marine resources are mainly sold outside the community (Table 13). In the case of invertebrates, there is no sale within either community. For finfish, only 33% of all fishers in Tumatata, and 44% of all fishers in Rumpus sell within their respective communities. However, all finfishers and all invertebrate fishers do sell outside the community.

Table 14: Example "Pacifica"—clients

Region	Village	Sold to (%)				
		Person-to-person	Shop	Market	Middleman/ agent	Restaurants
		Finfish				
Down Islands	Tumtata	33	33	89	0	0
Down Islands	Rumpus	33	0	100	0	0
		Invertebrates				
Down Islands	Tumtata	0	25	37.5	37.5	0
Down Islands	Rumpus	0	0	75	25	0

Target markets vary between both communities (Table 14). Most exports are to clients in Pacifica city, but Tumtata fishers sell finfish and invertebrates to shops and at the market place, while Rumpus fishers sell at the market place only. Knowledge of the range of invertebrate species that people in the communities surveyed consume or catch for sale only reveals that the percentage of invertebrates sold to a middleman or agent in Rumpus represents exclusively trochus and bêche-de-mer sales.

Based on the above figures we can conclude that the impact caused by Rumpus finfishers is determined by both subsistence and commercial needs. In the case of Tumtata, commercial fisheries serving an external market determine the main fishing pressure. Pressure on invertebrate resources depends on the type of fishery. While gleaning serves exclusively subsistence needs and is thus determined by the level of consumption only, dive fisheries are commercially oriented. Impacts of the latter are likely to cause adverse effects as they are subject to external pressures.

3.6 What is the total finfish catch worth at regional market prices?

WHY?

This is a simple way to assess the value of finfish used by a community or population at local market prices and in relation to prices for canned fish. Although this approach does not reflect the economic value of fish, it helps to provide a cash value for finfish resource use for planners and managers. This information can be useful for monitoring (gross value) and management purposes (i.e. advocacy) provided it is supplemented by other information. For example, the value of the total annual finfish catch of a certain population expressed in local or urban market prices in USD can be compared to the annual volume of a recognised commercial fishery in the same country. This comparison helps to illustrate the importance of reef and lagoon finfish resources to the livelihood of coastal people.

INPUT DATA

- Total annual finfish catch (kg) per year;
- Local price at community/village for reef and lagoon fish (local currency/kg);
- Local price at major urban market for reef and lagoon fish (local currency/kg);
- If necessary, conversion of local fish sale units (string, heap etc.) to kilograms;
- Local price for canned fish (average price for fish meat) (local currency/kg); and
- Exchange rate at time of survey for local currency/USD.
- Total annual catch (results from 3.4);

SOURCE

- Key informant—selected information and/or general information (Annex VII); checklist (Table 1).

OUTPUT

Using the applicable exchange rates, the cash value determined in USD for each village's finfish production is presented in an output table. USD values of total catch expressed in finfish prices at community and regional markets, and canned fish prices in urban centres, are given in a bar chart.

Table 15: Example "Pacifica": valuing total catch

Step 1: Convert average local market price and urban market price for finfish, and average price for canned fish (fish weight only), into USD (exchange rate at survey date $1 Pacifica = USD 0.456)

Site	Finfish average price/kg		Canned fish average price/kg	
	Pacifica $	USD	Pacifica $	USD
Tumtata	3.50	1.60	4.50	2.05
Rumpus	3.65	1.66	4.50	2.05
Pacifica capital	5.25	2.39	3.80	1.73

(Note: we use an average price per kilogram here, although there may be countries or markets where different prices apply for different reef and lagoon fish species or species groups. Because very often it is difficult to quantify the market proportion per species or species group, we believe that using the average price per kilogram for fresh reef and lagoon fish will suffice for this approximate calculation).

Step 2: Multiply total annual finfish catch (kg), and the proportions used for subsistence and for export by prices (per kg) in USD at local and urban markets (results from 3.5).

Step 3: Multiply total annual catch (kg) by average price for canned fish (USD/kg fish weight). Please note that the cost for canned fish thus determined can be used for local but not for regional comparison because a variety of other factors may vary substantially between sites.

Table 16: Finfish cash value

Region	Village	Total finfish catch (t/year)	USD value of total catch —community prices applied	USD value of total catch —regional market prices applied	USD cost as equivalent of canned fish prices (net weight)—urban market prices applied
Down Islands	Tumtata	43.3	69,280	103,487	74,909
Down Islands	Rumpus	43.2	71,712	103,248	74,736

(USD prices/kg apply as follows: local community prices are 1.60 for Tumtata, 1.66 for Rumpus; regional market price is 2.39; canned fish price at urban market is 1.7; total finfish catch in t/year is derived from Table 12 in Section 3.5.)

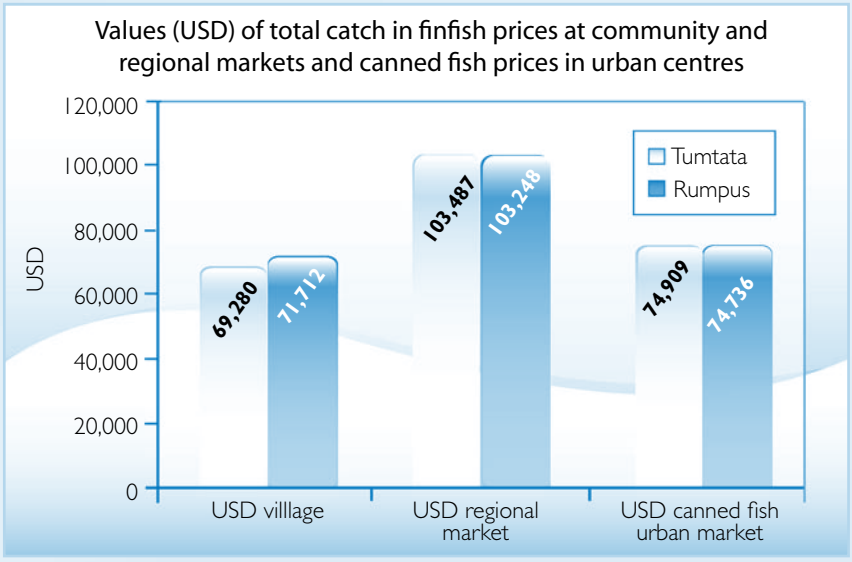


Figure 15: Example "Pacifica": value of total catch

Prices for finfish do not vary much between communities, but differ substantially from regional market prices (Table 16). The total catch value can be expressed in terms of urban prices for canned fish, or prices for finfish at regional markets. Comparisons show that using urban canned fish prices produces a lower value than using regional market prices for finfish. Differences in the value of finfish at community and regional market prices are accordingly as shown in Figure 15 above. Figure 15 also shows that the value of the total catch expressed in prices for canned fish at urban markets and in finfish at village markets is not significantly different.

In summary, the value of the total annual finfish catch for both villages is substantial, ranging from USD 69,280 to 103,487 per year, or equalling an annual per capita value of USD 262–391 for Tumtata (population of 265) and USD 282–407 for Rumpus (population of 254).

For instance, if we apply the finfish price at the next regional market to the proportion of the total annual catch for each community that is consumed or sold externally, we can estimate that the total value of the annual village consumption is USD 24,423 and USD 62,878 and for export is USD 79,064 and USD 40,370

for Tumtata and Rumpus, respectively. This calculation also shows that the value of the share of the total annual finfish catch used for subsistence and for income earning purposes varies considerably between both communities.

3.7 Which fishing strategies are used?

WHY? Fishing strategies provide insight into exploitation level and thus possible threat to the resource, level of investment, and gender participation. We therefore summarise major parameters by gender group.

INPUT DATA

- Percentage of fishers by fishery
- Habitats per fisheries targeted
- Time and periods of fishing
- Use of boat transport
- Techniques used
- Duration and frequency of fishing trips

SOURCE

- Finfisher survey (Annex III) / questions: F1, F2, F3, F4, F5, F6, F7
- Invertebrate fisher survey (Annex IV) / questions: IF1, IF2, IF3, IF4, IF5, IF6, IF7

OUTPUT Results of this section consist of a suite of tables summarising the major parameters that best characterise fishing strategies for both finfish and invertebrates.

Information is collected from men and women fishers. Accordingly, summary figures for fisheries strategies are summarised per gender group to show whether or not their fisheries strategies vary. Total figures may exceed 100% as multiple answers are possible.

Table 17: What is the purpose of catching fish?

Purpose of fishing	Tumtata		Rumpus	
	Men %	Women %	Men %	Women %
Sale of finfish	67	50	70	40
Sale of invertebrates: gleaning	20	12.5	25	25
Sale of invertebrates: diving	51	0	50	4
Home consumption of finfish	33	50	30	60
Home consumption of invertebrates: gleaning	20	87.5	20	71
Home consumption of invertebrates: diving	9	0	5	0

Table 18: Which habitats are mainly targeted by the community and are there differences between men and women fishers?

Habitats targeted for finfishing	Tumtata		Rumpus	
	Men %	Women %	Men %	Women %
Coastal reef	89	67	60	60
Lagoon	22	67	20	40
Outer reef	0	17	10	0
Mangrove	0	0	0	0
Pelagic/open ocean	22	0	20	0

(Note: the sum of all percentages for each gender group may exceed 100% because some fishers may target more than one habitat; if we disaggregate the percentage figures to avoid exceeding 100% in total, we lose information on the use of fishing strategies that target multi-habitats.)

Table 19: Are there differences between men and women in targeting invertebrate fisheries?

Invertebrate habitats and fisheries targeted	Tumtata		Rumpus	
Gleaning	Men %	Women %	Men %	Women %
Soft bottom (seagrass, sand)	0	14	29	63
Mangrove & mud	50	43	57	63
Reef top	63	86	29	63
Diving				
Bêche-de-mer	38	0	57	13
Lobster	38	0	43	0
Mother of pearl (trochus, pearl shell, etc.)	25	0	29	0
Others (giant clams, clams, octopus, etc.)	63	0	89	0

(Note: the sum of all percentages for each gender group may exceed 100% because some fishers may target more than one habitat; if we disaggregate the percentage figures to avoid exceeding 100% in total, we lose information on the use of fishing strategies that target multi-habitats.)

Table 20: When do men and women mostly fish?

Time of finfishing	Tumtata		Rumpus	
	Men %	Women %	Men %	Women %
Day	34	67	50	40
Night	0	0	10	40
Day and night	66	33	40	20
Time of invertebrate gleaning				
Day	100	100	100	100
Night	0	0	0	0
Day and night	0	0	0	0
Time of invertebrate diving				
Day	33	100	50	0
Night	0	0	0	0
Day and night	67	0	50	0

Table 21: Do men and women fishers use boat transport?

Use of boat transport for finfishing (Average for all habitats targeted)	Tumtata		Rumpus	
	Men %	Women %	Men %	Women %
Always	33	33	40	40
Sometimes	11	17	20	20
Never	56	50	40	40
Gleaning				
Always	0	0	0	0
Sometimes	0	0	0	0
Never	100	100	100	100
Diving				
Always	43	0	12.5	0
Sometimes	43	0	37.5	0
Never	14	100	50	100

Table 22: What are the major fishing techniques used by men and women fishers?

Use of finfishing techniques	Tumtata		Rumpus	
	Men %	Women %	Men %	Women %
Handline	67	33	80	40
Castnet	11	17	20	0
Spear (diving)	22	33	20	60
Trolling	22	0	20	0
Gillnet	56	50	50	100
Handheld spear (Walk)	11	17	0	40
Handheld spear (Canoe)	0	0	0	0
Deep bottom line	0	0	0	0
Others, specify: _____	1	1	0	0

(Note: the sum of all percentages for each gender group may exceed 100% because most fishers use more than one technique in general, or even during one fishing trip; if we disaggregate the percentage figures to avoid exceeding 100% in total, we lose information on the use of multi-technique fishing strategies.)

In the following table (Table 23), we establish average frequency, duration, period, and number of techniques used on fishing trips by men and women fishers.

Table 23: Selected parameters to characterise fishing strategies for different fisheries in both communities

Selected parameters for finfisheries	Tumata		Rumpus	
	Men %	Women %	Men %	Women %
Frequency of fishing (sum of all habitats visited) (times/week) *(question F3)*	2.08	2.04	1.85	1.5
Average duration of fishing trip (hours) *(question F3)*	4.2	3.7	4.5	3.8
Average number of months fished per year (*question F3*)	10.8	12	10.4	11.6
Use of one technique per trip only (%) (*question F7*)	78	100	70	60
Selected parameters for invertebrate fisheries				
Gleaning				
Frequency of gleaning (sum of all habitats visited) (times/week) (*question IF4*)	1.3	2.4	1.1	1.9
Average duration of gleaning trip (hours) (*question IF4*)	2.3	2.6	1.9	2.9
Average number of months you glean per year (*question IF4*)	5.9	9.4	5.1	8.8
Diving				
Frequency of diving (sum of all habitats visited) (times/week) (*question IF5*)	1.7	0.1	1.6	0
Average duration of dive trip (hours) (*question IF5*)	4.7	0	3.9	0
Average number of months dived per year (*question IF5*)	7.1	0.4	5.4	0

About half of the women catch finfish, but very few also harvest invertebrates for sale (Table 17). Male fishers are mainly commercially oriented, both for finfish and invertebrates. All fishers target mostly coastal reef and lagoon habitats, and only men fish for pelagic fish or in the open sea (Table 18). Some men from Tumtata, and surprisingly a few women from Rumpus, fish at the outer reef. For invertebrates, Tumtata women and men mainly target the reef top, but also the mangrove and mud fishery. In the case of Rumpus, women target equally soft bottom, mangrove and mud, and reef top fisheries, while men mainly glean mangrove and mud areas (Table 19). Men invertebrate fishers from both villages dive for giant clams, followed by bêche-de-mer, lobster, and finally trochus. Only a few women from Rumpus participate in bêche-de-mer harvesting.

About half of all fishers go out exclusively during the day, while the other half fishes night and day, suggesting that tidal conditions are more important than time of finfishing as such (Table 20). Reef gleaning is exclusively performed during the day, while some diving for invertebrates, such as lobster, is also performed at night.

The use of boat transport is not gender related. However, boats are used slightly more often in Rumpus than in Tumtata. Boats are never used for reef gleaning, but are necessary to dive for certain invertebrate species (Table 21).

Fishing techniques vary, but mostly only one technique is employed during one trip. Handlines, spear diving and gillnetting are the main techniques used for finfisheries. The percentage of women using spear diving and gillnetting is surprisingly high in both communities, but particularly so in Rumpus. Trolling is done only by men and is explained by those fishing for pelagics (Table 22).

Time spent in terms of frequency, duration of one fishing trip, and months of the year does not vary substantially between villages and gender. Fishing trips occur about twice a week throughout most months of the year and each trip takes between 3 and 4 hours.

Invertebrate fishing is generally performed less frequently than finfishing, with shorter average trip durations. Gleaning and diving for invertebrates is done by men during half the year, but women glean during 9 months on average.

Fishing strategy parameters highlight the subsistence to small-scale artisanal nature of both fisheries in both communities. Transport and techniques used suggest low investment costs but relatively high labour input.

Traditionally, there may be specific roles for men and women in coastal fisheries. Wherever possible, we have distinguished between men and women fishers in order to recognise their roles in the fishery. This is important when determining management strategies.

3.8 Gender issues

WHY?

One of the traditional roles for women in the Pacific region is invertebrate collection rather than finfishing. Thus, the proportion of women engaged in finfisheries and invertebrate harvesting may indicate social changes, and demonstrate how far traditional roles have already been broadened.

The comparison of the major purposes of fishing between gender groups will demonstrate whether or not women are mostly responsible for ensuring protein and food supply for the family, or are also significantly involved in generating cash income from exploitation of marine resources. This is an important input for tailoring management strategies to the appropriate target groups of fishers.

Comparisons of average catch, catch per unit effort (CPUE) and the contribution of women to the community's total annual catch show whether there are any major efficiency differences between men and women fishers. Explanations for major differences may also be found by comparing fishing strategies applied by men and women (results from Section 3.7), using figures for the average catch by gender group (results from Section 3.3). The CPUE is determined by dividing the average catch (kg/trip) by the average duration (hours) of a fishing trip. This is done separately for all men and women fishers. Thus, we define CPUE as the average catch per hour spent on fishing (including preparation, transport to and from fishing grounds, and landing).

INPUT DATA

- Men and women fishers (number, percentage)
- Catch data, fishing trip duration data
- Results from Section 3.2.4 (Number of fishers), Section 3.3 (How much is taken by whom?)

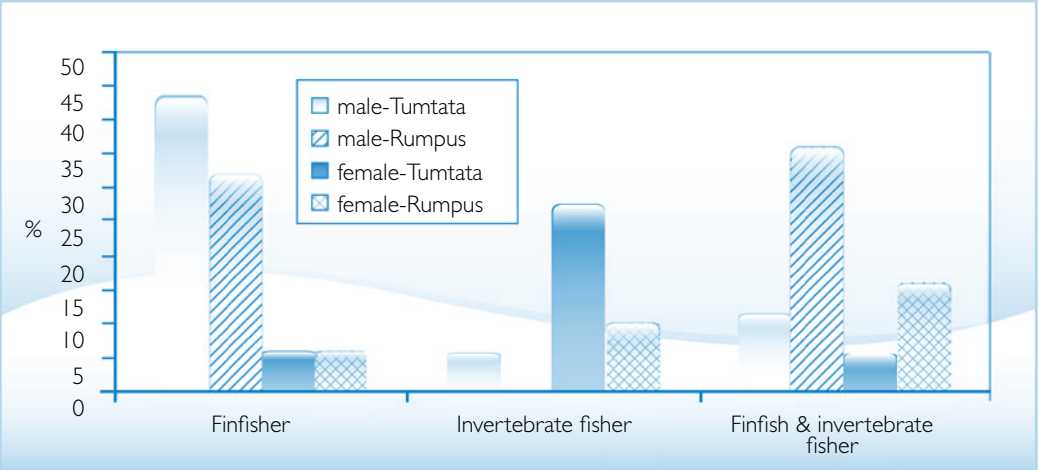
SOURCE

- Finfisheries survey (Annex III) / questions: F1, F2, F3, F8

OUTPUT

An overview of the proportion of men and women fishers is given in a bar chart. Catch per unit effort (CPUE) and average catch by gender are shown in both tables and bar charts to facilitate detection of similarities and differences between the productivity of men and women fishers.

Information is collected from men and women fishers. Accordingly, summary figures for fishing strategies are summarised per gender group to show whether or not their strategies vary. Total figures may exceed 100% as multiple answers are possible.



(This figure depicts the extrapolated total numbers of fishers by gender and type of fishing activity in both communities in percentages; refer to Section 3.2.4, Step 3)

Figure 16: Example "Pacifica": proportion of men and women fishers

Table 24: Finfish catch rates by gender

Region	Village	Average catch kg/trip		CPUE (kg/hour)	
		Men	Women	Men	Women
Down Islands	Tumtata	11.8	10.5	2.94	3.10
Down Islands	Rumpus	11.1	8.2	3.35	2.15

(The average catch kg/trip is the summary of the average catch figures given by all women and men fishers interviewed in both communities; refer to question F9 of the finfisher survey questionnaire form. The CPUE is the average productivity derived from questions F9 (average catch per trip) and F4 (average duration of fishing trips) of the finfisher survey questionnaire form; refer to Annex III).

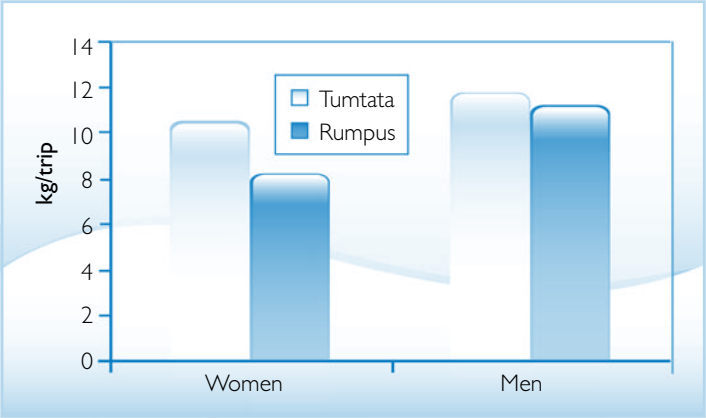


Figure 17: Example "Pacifica": finfish catch by gender (kg/trip)

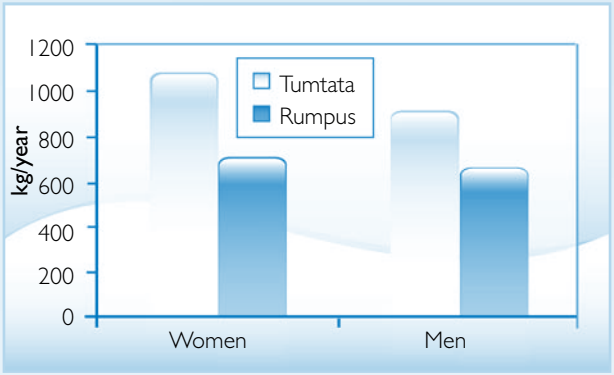


Figure 18: Example "Pacifica": annual finfish catch by gender (kg/year)

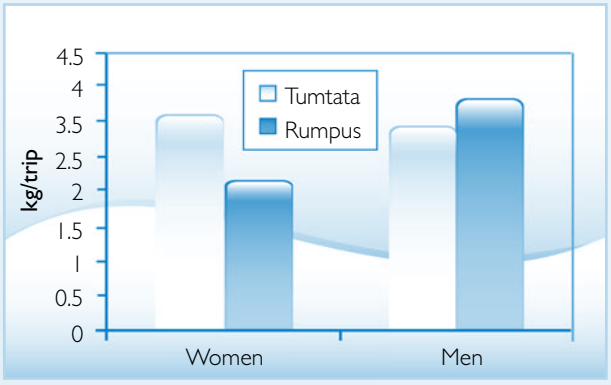


Figure 19: Example "Pacifica": CPUE (finfish) by gender

The above figures support our earlier findings that fisheries (finfish and invertebrates) are dominated in Rumpus by men and in Tumtata by men for finfish and by women for invertebrates (Figure 16).

However, while the average finfish catch per trip by men fishers in slightly higher than that of women fishers (Figure 17; Table 24) the opposite is true for the average annual catch (Figure 18). Also, for Tumtata women fishers have a slightly higher average catch per unit effort (CPUE) than men fishers. In Rumpus, CPUE of men fishers exceeds that of women finfishers (Figure 19).

There are still signs of traditional gender roles, i.e. men are more involved in fisheries, in particular in finfisheries. However, women who finfish are as successful as men at taking catches. Taking into account that commercial fisheries play a role in both communities, results indicate that the higher participation of men in finfisheries accounts for the fact that they have higher annual commercial catch volumes than women. Although the proportion of female fishers who only target finfish (no invertebrates) is small in both communities, female participation in invertebrate and mixed fisheries (finfish and invertebrates) should be taken into account for management planning.

3.9 How does the community keep the fish?

WHY?

Information on whether a community uses preservation and storage methods, and which methods are commonly used, helps planners and managers to assess the potential for food security and marketing. The more frequently preservation methods are used, in particular refrigeration and freezing, the less dependent a community is on fisheries. This is because temporary shortfalls in the supply of reef and lagoon resources can be easily bridged, and fishing can be performed less frequently, more effectively and more flexibly. Increased availability of refrigeration and freezing methods improves quality, time for storage and transport, and thus marketability of reef and lagoon resources. In terms of fisheries management, knowledge on the availability of preservation and storage methods can be helpful for food security strategies and generating

income as well as for use in counteracting seasonal supplies in fisheries. However, preservation facilities may also trigger adverse effects by increasing fishing pressure due to the improved marketability of catches.

INPUT DATA

- Preservation and storage methods used
- Frequency of preservation and storage methods used
- Processing level

SOURCE

- Finfisher survey (Annex III) / question: F12
- Invertebrate fisher survey (Annex IV) / question: IF8

OUTPUT

Results are summarized in two tables. Table 25 gives the frequency of each method used as a percentage of the total number of individual fishers surveyed in each village. Multiple entries are possible. Therefore percentages may not add up to 100%.

Figure 20 summarises how regularly any of the methods are used in each village (Finfisher survey questionnaire form (Annex III) / question F12). Figures are percentages of the total reported numbers for each technique.

Table 26 summarises only those techniques that are used to process marketed invertebrates. It provides insight into the skills and techniques already available.

Table 25: Example "Pacifica": preservation and storage methods used

Region	Village	Method	Frequency of use in % of fishers interviewed (total n=15)		
			Always	Sometimes	Never
Down Islands	Tumtata	Refrigeration	13	0	87
		Freezing	7	0	93
		Smoking	0	27	73
		Drying	0	0	100
		Other	0	0	100
		Ice used on fishing trip	13	13	74
	Rumpus	Refrigeration	20	0	80
		Freezing	0	20	80
		Smoking	7	13	80
		Drying	27	0	73
		Other	0	0	100
		Ice used on fishing trip	13	13	74

A list of "other" preservation and storage methods needs to be compiled if applicable.

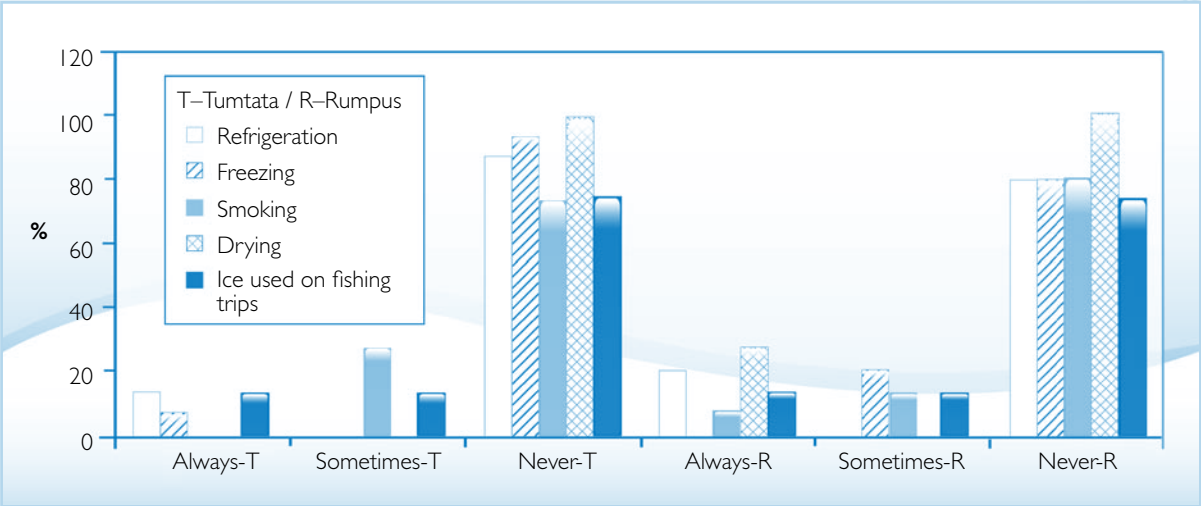


Figure 20: Finfish preservation methods used in both communities

Table 26: Invertebrate processing level

Region	Village	Species		Processing level (%)		
				Always	Sometimes	Never
Down Islands	Tumtata	Bêche-de-mer	Dried	100	0	0
		Crab-A	Alive	60	40	0
		Lobster	Alive	80	20	0
		Trochus	Shell only	70	0	30
	Rumpus	Bêche-de-mer	Dried	90	10	0
		Crab-A	Alive	100	0	0
		Lobster	Alive	100	0	0
		Trochus	Shell only	60	20	20

Finfish preservation and storage are not common in either community (Table 25). There is little cooling and freezing capacity and alternative preservation and storage methods, such as smoking or drying are little used. Similarly, ice is rarely taken on fishing trips by Tumtata and Rumpus fishers (Figure 20).

The characteristics of commercial invertebrate fisheries are similar (Table 26). Species are predominantly sold alive (lobster, crabs), shell only (trochus) or dried (bêche-de-mer), and cooling or freezing treatments are not used.

The data suggest that finfish is harvested without the support of a cooling chain or alternative preservation methods. The lack of these facilities affects the duration of fishing trips and the turnover rate for consumption and sale. Limited preservation and storage methods may also be considered a major constraint to any commercial development scheme, and may be a focal point for food safety issues. However, recommending the use of ice during fishing trips and/or for preservation of catch until marketing will probably generate additional costs. Therefore, the extra time and effort required by fishers need to be taken into account.

3.10 How much is known about existing fisheries management rules?

WHY?

This subject differs from all others in that data collected on knowledge of existing fisheries management rules involves perception rather than something quantitatively measurable. This question has not been included in the set of questions addressing households or individual fishers, but in the more general survey that targets key informants.

The objective of this subject is to evaluate existing fisheries management rules and regulations in terms of awareness rather than compliance. Lack of compliance can be the result of a variety of factors, including:

- Ignorance;
- Lack of enforcement (lack of resources to establish an effective enforcement system; low priority given to this issue; lack of political will; lack of coordination by authorities; corruption and backhanders/bribery);
- Conflict between customary and legislated rules; and
- Physical nature of the fishery (by-catch rates).

Learning about the level of compliance with existing and known rules and regulations and reasons for failure is crucial to improving fisheries management. To achieve this, tenure of fishing grounds must be taken into account.

INPUT DATA

- Map and local names of fishing grounds used;
- Tenure of fishing grounds;
- Knowledge of regulations made by Fisheries and the community, and level of compliance with them (and if applicable, reasons for non-compliance) by fishers from the community and external to the community.

SOURCE

Key informant survey (Annex V) / questions: K1, K2, K3, K4, K5, K6, K7

OUTPUT

Information collected needs to be presented individually for each survey and community or population. We suggest presenting results using the following guidelines:

- Sketch or map of the fishing grounds, including names, that are either owned or fished by people from the community(ies) surveyed;
- Table showing present tenure of fishing grounds;
- Table summarising knowledge and compliance with rules and regulations for marine resource utilisation.

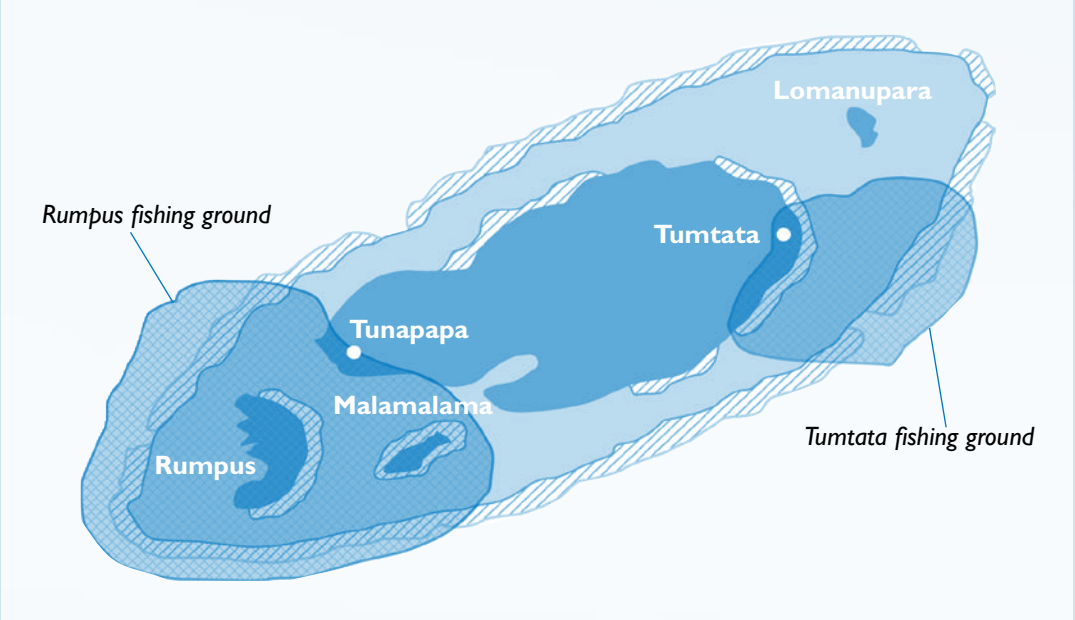


Figure 21: Example "Pacifica": map of fishing grounds and local names

Table 27: Tenure of fishing grounds

Tenure of fishing grounds	"Community owned"
List of other villages using the same fishing ground	Malamalama village (regularly)
	Tunapapa village (sometimes)
	Lomanupara village (rarely)

The above map (Figure 21) shows the fishing ground that is owned by the communities of Tumtata and Rumpus. However, three other villages in the vicinity also use their fishing grounds, particularly fishers from Malamalama. People from Tunapapa fish here less frequently, and those from Lomanupara fish here only rarely.

Table 28: Fisheries rules and regulations

Rule/regulation	Authority		Known		Compliance					
					Community			External users		
	Government	Community	Yes	No	+	+/–	–	+	+/–	–
Lobster catch size	✓		✓			✓				✓
Mesh size for gill-nets regulated	✓		✓		✓				✓	
Use of traditional poison prohibited		✓	✓		✓			✓		
Seasonal closure of reefs		✓	✓		✓				✓	

(+ mostly comply; +/– sometimes comply; – do not really comply)

Table 29: Reasons for non-compliance with fisheries rules and regulations

Rule/regulation	Reasons for non-compliance
Lobster catch size	Lack of surveillance (they get away with it)
Mesh size for gillnets regulated	No enforcement measures to stop use of smaller mesh sizes
Seasonal closure of reefs	Difficult to control fishing activities that take place at night and at reefs further away

There are a number of government and community rules and regulations, and both sets of rules and regulations are known by fishers (Table 28). However, while compliance with both sets of rules and regulations is high amongst fishers from both villages, external fishers violate some of these. Apparently, the lack of surveillance and enforcement measures is the main factor that determines why external fishers get away with non-compliant fishing activities (Table 29). This highlights the need to ensure that all communities using the same fishing ground are involved in fisheries management, rather than focusing on one user group only.

ANNEXES

Annex I

SURVEY OF SOCIOECONOMIC INFORMATION NEEDS OF PACIFIC REGIONAL FISHERIES AUTHORITIES

Fisheries authorities survey—Determining framework of SE Manual

The minimum dataset required from socioeconomic surveys as described by this manual is based on the information needs expressed by the fisheries services of Pacific island countries and territories. At the end of 2003, the following short questionnaire was submitted to fisheries services in each of the eight ACP (African, Caribbean and Pacific Group of States) member countries eligible under PROCFish/C, and the three OCTs (Overseas Countries and Territories) and six ACP member countries eligible under CoFish. Of the 17 countries contacted, replies were obtained from 13 (= 77%). Their answers are summarised below.

Additional information requested was assessed for inclusion in the proposed manual. Information that exceeded the proposed framework, or that was country specific, was not included.

Survey to compile household-based fisheries survey in PICTs (Pacific Island countries and territories)

No.	Objective	A survey implemented in your country should (YES) or should not (NO) answer which of the following questions (please tick ✓)	
		YES	NO
1	How much is taken by whom? (including gender)		
2	What is harvested?		
3	What is the per capita consumption of a particular community?		
4	What does the community do with the catch?		
5	What is the total catch worth at local market prices?		
6	What are the fishing strategies? (including transport)		
7	How do they keep the fish? (post-harvesting techniques)		
8	Which and what knowledge exists of fisheries management rules? (legal, traditional, community)		
Any more questions not covered?			

RESULTS: Summary of answers obtained from fisheries authorities in PICTs

Number of responding countries = 13 (100%)

No.	Question	Yes	No
1	How much is taken by whom? (including gender)	100%	
2	What is harvested? *(specific species groups, such as finfish, invertebrates)*	100%	
3	What is the per capita consumption of a particular community?	91%	9%
4	What does the community do with the catch?	91%	9%
5	What is the total catch worth at local market prices? *(nominal value; 1st sale price)*	91%	9%
6	What are the fishing strategies? (including transport, *particularly which types of boats are used)*	85%	15%
7	How do they keep the fish? (post-harvesting techniques)	85%	15%
8	Which and what knowledge exists of fisheries management rules? (legal, traditional, community)	92%	8%

(Comments in italics are explanations/requests by some of the respondents)

In addition, the following issues were raised, some of which have been incorporated into the SE survey format.

Country		Issue	Comments
Fiji	1	Main sources of livelihood	*Included*
	2	Perception of education in improving role of living standard	*More of a community-based approach than part of this manual*
	3	Perception of status/trends of natural fisheries resources	
	4	Perceived problems and solutions	
	5	Exploitation/harvest level and patterns of fishing	*Should be possible to assess using a comparative approach between indirect information gathered from different sites; however, direct approach requires underwater resource assessment*
	6	Knowledge of reef fish spawning aggregations	*?*

Country		Issue	Comments
Solomon Islands	1	What is harvested, what is most important?	*Will be one of the results*
	2	Frequency of fishing by household	*Included*
Tuvalu	1	What fish is mostly/commonly consumed?	*Frequency tables possible output*
	2	How frequently fish is consumed?	*Included*
	3	What are alternative sources of protein?	*Only for canned fish*
	4	What is frequency of consumption of other sources?	*Only for canned fish*
New Caledonia	1	Areas/habitats harvested (reef flats, lagoon, barrier reefs, etc.)	*Included*
	2	Fishing frequencies	*Frequencies of fishing trips, included*
	3	No. of persons in fisheries per community	*Extrapolated output*
	4	Distinction between leisure/ subsistence	*Applies to French Territories only*
Nauru	1	Like to sell catch at fish market	*More of a management survey*
	2	Interest in learning post-harvest methods	
	3	Need to implement fisheries management rules	
	4	Need to establish a no-take (MPA) zone by law/conservation	
	5	What is (generally) purpose of Nauru Fisheries Authority?	
Niue	1	What is the number of boats, frequency of use (effort)?	*Use of boats is included; fishing effort, however, is another question; calculated CPUEs are an output*
	2	Prices for fish, fluctuations and proportions of non-monetary distribution	*Included*

Generally speaking, the proposed framework of the SE Manual will satisfy the identified information needs (82–100%) of fisheries services in the region. Additional information requested was either found to exceed the framework of reef and lagoon fisheries, or represented a specific individual need of only one or a few countries.

Annex II

HOUSEHOLD DEMOGRAPHY AND CONSUMPTION SURVEY QUESTIONNAIRE FORM

Target group

- ❑ Head of household, or
- ❑ Women responsible for preparing food for the household

Objective: To gather detailed information on:

- ❑ average household size and composition
- ❑ average household consumption pattern
- ❑ average number of fishers by gender, and
- ❑ average number of boats per household

Village / Place	
Household no.	
Date	
Name of surveyor	

Person interviewed (*confidential information, names will not be published*)			
Name	Age (years)	Gender	
		Male	Female

HH.1 How many people usually live and eat in your household?	Enter number of people			
HH.2 What are the ages of the male and female members in this household? (Include children and older people; please only quote persons living permanently in this household)	Males		Females	
	No.	Age (or year of birth)	No.	Age (or year of birth)
	1		1	
	2		2	
	3		3	
	4		4	
	5		5	
	6		6	

HH.3 How many people in your household fish or collect on reefs and in the lagoon regularly? (Do not include people who only fish once or twice a year)

Invertebrate fishers	Male	☐	Female	☐
Finfishers	Male	☐	Female	☐
Invertebrate and finfishers	Male	☐	Female	☐

HH.4 Does this household own a boat?

yes ☐ no ☐

How many? ☐

Which type? _____

No. of canoes ☐

No. of sailboats ☐

No. of motorized boats ☐

HH.5 Where does the cash money in this household come from? (Only list the sources of money contributed by people who live here usually) (rank options, 1 = most money; 2 = second most important income source; 3 = third most important income source; 4 = least important income source)

tick ✓	Source of income	Rank (1-4)
☐	Fishing/seafood collection	☐
☐	Agriculture	☐
☐	Salary	☐
☐	Other (handicrafts, etc.)	☐

↓

Specify: _____

HH.6 During an average/normal week, how many days do you prepare fish, other seafood and canned fish for your family? (Tick ✓ box)

	Number of days per week							
	7	6	5	4	3	2	1	Or specify
Fresh fish								
Other seafood								
Canned fish								

HH.7 On average, how much do you cook per day for your household?

FINFISH (enter no. of fish per size class, using size chart – tool used while interviewing)

Size class	A	B	C	D	E	E+ cm: _____
No. of fish						
or kg						

OTHER SEAFOOD (enter data using size charts – tools used while interviewing)

Seafood (name)	No.	Size	kg

HH.8 On a day when you prepare canned fish, how many cans do you use on average/normally for the household? (Enter no. of cans per day)

Size of can	No. cans/day
Small	
Medium	
Large	

HH.9 Where do you normally get your fresh fish from, and which source is the most common? (Tick ✓ box and rank from 1 to 3)

(1 = most common; 2 = second most common; 3 = least common source)

	tick ✓	rank (1–3)
Caught by me or someone else from this household	☐	☐
Get it from someone else (no money paid)	☐	☐
Buy it; name place: _____	☐	☐

HH.10 Where do you normally get your invertebrates (creatures from the sea other than fish) from, and which source is the most common? (Tick ✓ box and rank from 1 to 3)

(1 = most common; 2 = second most common; 3 = least common source)

	tick ✓	rank (1–3)
Caught by me or someone else from this household	☐	☐
Get it from someone else (no money paid)	☐	☐
Buy it; name place: _____	☐	☐

THANK YOU!

Annex III

FINFISHER SURVEY QUESTIONNAIRE FORM

Target group

- ❑ Fishers (men and women 15 years and older) from households surveyed

Objective: To gather detailed information on:

- ❑ average catch size and composition
- ❑ fishing techniques
- ❑ proportions of catch for subsistence, gift and sale
- ❑ methods of conserving and preserving seafood

Village / Place	
Household no.	
Date	
Name of surveyor	

Person interviewed (*confidential information, names will not be published*)			
Name	Age (years)	Gender	
		Male	Female

F.1	**Which areas do you fish? (Tick ✓ boxes and use chart)**	coastal reef ☐ lagoon ☐ mangrove ☐ outer reef (including passages) ☐ pelagic/ open ocean ☐	
F.2	**Do you fish only one of the habitats that you target at a time—or do you usually visit several during one fishing trip? If so, which ones do you usually combine during one fishing trip? (please fill in)**	Habitat	only targeted (tick ✓)	targeted together with habitat (fill in)
		Coastal reef		
		Lagoon		
		Mangrove		
		Outer reef (incl. passages)		
		Pelagic/open ocean		

F.3	**How often do you visit each habitat in a week, or a combination of habitats?** **How many hours does the average fishing trip take to this habitat, or combination of habitats?** **How many months in a year do you fish this habitat / combination of habitats?**	Coastal reef ☐ Lagoon ☐ Outer reef ☐ Mangrove ☐ Times/week: _____ Hours/trip: _____ Months/year: _____
F.3	***continue***	Coastal reef ☐ Lagoon ☐ Outer reef ☐ Mangrove ☐ Times/week: _____ Hours/trip: _____ Months/year: _____
F.3	***continue***	Coastal reef ☐ Lagoon ☐ Outer reef ☐ Mangrove ☐ Times/week: _____ Hours/trip: _____ Months/year: _____
F.3	***continue***	Coastal reef ☐ Lagoon ☐ Outer reef ☐ Mangrove ☐ Times/week: _____ Hours/trip: _____ Months/year: _____
Please select your most important habitat (or combination of habitats mostly fished during one fishing trip) and answer the following questions:		Most important habitat (or habitat combination) (fill in): _____

F.4 Do you use a boat for fishing?

Always ☐ Sometimes ☐ Never ☐

F.5 When do you go fishing? (Tick ✓ box)

Only during the day ☐

Only during the night ☐

Day and night ☐

F.6 Which fishing techniques do you use? (Tick ✓ boxes)

Handlining ☐ Spearfishing (diving) ☐

Castnetting ☐ Trolling ☐

Gillnetting: ☐ Mesh size (in inches or cm) _____

Spearing while walking ☐ Spearing while canoeing ☐

Deep bottom handlining ☐

Other techniques (specify):

_____

F.7 Do you use only one technique per fishing trip, or do you use several during one trip? (Tick ✓ box) If you use more than one, which techniques do you combine during one trip? (List)

☐ One technique/trip

☐ More than one technique/trip

↓

Which ones? _____ +

_____ + _____

F.8 How much do you catch during a normal fishing trip (your catch or share of catch only)? (Use size charts)

Size class:	A	B	C	D	E	E+:	cm
No. of fish:	☐	☐	☐	☐	☐	☐	_____
Or kg:	☐	☐	☐	☐	☐	☐	_____

F.9 On an average/normal fishing trip as above, what kinds of fish do you catch? (Fill in the names and numbers per size class)

Figures are numbers? ☐

or kg? ☐

Technique used most often to get this catch?

_____

Name of fish	Size class (use size chart)						
	A	B	C	D	E	E+	cm

F.10 **Do you sell your fish? (Tick ✓ box)**
If yes, where?

Yes ☐ No ☐

Within the community ☐

Outside the community, Which place? ☐

_____

F.11 **To whom do you sell? (Tick ✓ box)**

Individuals (door-to-door, along roadside) ☐

Shop ☐ Middleman/ agent ☐

Market ☐ Restaurants ☐

F.12 **Which preservation method do you use for your catch? (Tick ✓ box)**

☐ None

tick ✓	method	Always	Some-times	Never
☐	Ice (during fishing trips)	☐	☐	☐
☐	Refrigeration	☐	☐	☐
☐	Freezing	☐	☐	☐
☐	Smoking	☐	☐	☐
☐	Drying	☐	☐	☐
☐	Other method—specify:			
	_____	☐	☐	☐
	_____	☐	☐	☐

THANK YOU !

Annex IV

INVERTEBRATE FISHER SURVEY QUESTIONNAIRE FORM

Target group

- ❑ Fishers (men and women 15 years and older) from households surveyed

Objective: To gather detailed information on:

- ❑ average catch size and composition
- ❑ fishing techniques
- ❑ proportions of catch for subsistence, gift and sale
- ❑ methods of conserving and preserving seafood

Village / Place	
Household no.	
Date	
Name of surveyor	

Person interviewed (*confidential information, names will not be published*)			
Name	Age (years)	Gender	
		Male	Female

IF.1 In which areas do you collect sea animals other than fish? (Tick ✓ boxes and use chart)	***Gleaning :*** Soft bottom (seagrass, sand) ☐ Mangroves and mud ☐ Reef tops ☐
IF.2 Which sea animals other than fish do you dive for? (Tick ✓ boxes)	***Diving :*** Bêche-de-mer ☐ Lobster ☐ Mother of pearl, trochus, pearl shell, etc. ☐ Other animals (e.g. clams, octopus) ☐

IF.3 Do you glean only one of the habitats that you target at a time—or do you usually visit several during one gleaning trip? If so, which ones do you usually combine during one gleaning trip? (please fill in)	Habitat	Only targeted in 1 gleaning trip (Tick ✓)	Gleaned together with habitat in 1 gleaning trip (Fill in)
	Soft bottom (Seagrass,sand)		
	Mangrove and mud		
	Reef tops		

IF.4 Please answer the following questions for each habitat that you glean or the combined habitats that you glean during one fishing trip

Soft bottom (seagrass, sand) ☐
Mangrove and mud ☐
Reef tops ☐

How often do you go gleaning? ______ times/week
Do you use boat transport? always ☐ sometimes ☐ never ☐
How long is your gleaning trip? ______ hours/trip
What time do you glean? day ☐ night ☐ day/night ☐
You glean how many months in a year? ______ month/year

Soft bottom (seagrass, sand) ☐
Mangrove and mud ☐
Reef tops ☐

How often do you go gleaning? ______ times/week
Do you use boat transport? always ☐ sometimes ☐ never ☐
How long is your gleaning trip? ______ hours/trip
What time do you glean? day ☐ night ☐ day/night ☐
You glean how many months in a year? ______ month/year

Soft bottom (seagrass, sand) ☐
Mangrove and mud ☐
Reef tops ☐

How often do you go gleaning? ______ times/week
Do you use boat transport? always ☐ sometimes ☐ never ☐
How long is your gleaning trip? ______ hours/trip
What time do you glean? day ☐ night ☐ day/night ☐
You glean how many months in a year? ______ month/year

IF.5 Please answer the following questions for each of your dive invertebrate fisheries

Beche-de-mer ☐
MoP (trochus, pearl shell) ☐
Lobster ☐
Other (clams, octopus, etc.) ☐

How often do you go diving? _____ times/week
Do you use boat transport? always ☐ sometimes ☐ never ☐
How long is your diving trip? _____ hours/trip
What time do you dive? day ☐ night ☐ day/ night ☐
You dive how many months in a year? _____ month/year

Beche-de-mer ☐
MoP (trochus, pearl shell) ☐
Lobster ☐
Other (clams, octopus, etc.) ☐

How often do you go diving? _____ times/week
Do you use boat transport? always ☐ sometimes ☐ never ☐
How long is your diving trip? _____ hours/trip
What time do you dive? day ☐ night ☐ day/ night ☐
You dive how many months in a year? _____ month/year

Beche-de-mer ☐
MoP (trochus, pearl shell) ☐
Lobster ☐
Other (clams, octopus, etc.) ☐

How often do you go divng? _____ times/week
Do you use boat transport? always ☐ sometimes ☐ never ☐
How long is your diving trip? _____ hours/trip
What time do you dive? day ☐ night ☐ day/ night ☐
You dive how many months in a year? _____ month/year

Beche-de-mer ☐
MoP (trochus, pearl shell) ☐
Lobster ☐
Other (clams, octopus, etc.) ☐

How often do you go diving? _____ times/week
Do you use boat transport? always ☐ sometimes ☐ never ☐
How long is your diving trip? _____ hours/trip
What time do you glean? day ☐ night ☐ day/ night ☐
You dive how many months in a year? _____ month/year

Please select your most important habitat (or combination of habitats that you **GLEAN** during one fishing trip), for which you will answer the following questions	Most important habitat (or habitat combination) (fill in): _____

IF.6 On a normal gleaning trip, what species do you catch? (Fill in the names and numbers per size class) (use size charts)

Vernacular name	Total number/ trip	Average size (cm)	Total kg/trip	Used for			
				Consumption	Gift	Sale	
						In village	Elsewhere

IF.7 On a normal dive trip, what do you usually catch? (Fill in the names and numbers or kg per size class and per fishery) (use size charts)

Bêche-de-mer ☐ MoP (trochus, pearl shell) ☐ Lobster ☐ Other (clams, octopus, etc.) ☐

Vernacular name	Total number/ trip	Average size (cm)	Total kg/trip	Used for:			
				Consumption	Gift	Sale	
						In village	Elsewhere

Bêche-de-mer ☐ MoP (trochus, pearl shell) ☐ Lobster ☐ Other (clams, octopus, etc.) ☐

Vernacular name	Total number/ trip	Average size (cm)	Total kg/trip	Used for:			
				Consumption	Gift	Sale	
						In village	Elsewhere

Bêche-de-mer	MoP (trochus, pearl shell)	Lobster	Other (clams, octopus, etc.)
☐	☐	☐	☐

Vernacular name	Total number/ trip	Average size (cm)	Total kg/trip	Used for:			
				Consumption	Gift	Sale	
						In village	Elsewhere

IF.8 Which preservation method do you use for your catch? (Tick ✓ boxes)

☐ None

Species:	Fresh/meat	Dried	Shell	Smoked	Other:	Specify:
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	

THANK YOU!

Annex V

KEY INFORMANT SURVEY QUESTIONNAIRE FORM

Target group

- ❑ Key informants (men and women) in the community(ies) (for example, chiefs, village elders, priests, spokespersons, community leaders, leaders of women's and youth groups) who have a good insight into the general perceptions and attitudes of marine resource use and management

Objective: To learn about:

- ❑ locations and names of fishing grounds
- ❑ management rules (known and applied)
- ❑ major recurrent problems related to marine resource management in the community
- ❑ selected information on marketing and costs
- ❑ vernacular names
- ❑ seasonality of species

Village / Place	
Household no.	
Date	
Name of surveyor	

Person interviewed (*confidential information, names will not be published*)			
Name	Age (years)	Gender	
		Male	Female

K.1 Record the areas and names of fishing grounds used by the community.	*Prepare a map of the area, or use a nautical chart if available. Indicate areas, places and names of fishing, diving and gleaning grounds used.*
K.2 Who owns the reefs and fishing grounds?	Community ☐ Open access ☐ Individual ownership ☐ Jointly owned with other villages ☐ List names of villages: _____ _____

K.3	**Are the fishing grounds in this village used by other villages?** **If yes, who uses them? (List names of other villages)**	Yes ☐ No ☐ ↓ By whom? _____
K.4	**Are the people in your village aware of the regulations issued by the Department/Ministry of Fisheries?** **And do they comply with the regulations?** **If they do not comply with the regulations, why not?**	Yes ☐ No ☐ ↓ Mostly ☐ Sometimes ☐ Not really ☐ ↓ ↓ _____
K.5	**Has this community made its own rules and regulations (including customary rules)?** **If yes, what are they?**	Yes ☐ No ☐ ↓ _____
K.6	**Does the community respect these rules and regulations?** **If not, why not?**	Yes ☐ No ☐ ↓ _____
K.7	**If the fishing grounds are used by fishers from other villages, do these other fishers respect the government regulations and/or community rules?** **If not, why not?**	Yes ☐ No ☐ ↓ _____

K.8	**Do people sell their catch in the community?**	Yes ☐ No ☐ Reef and lagoon fish Yes ☐ No ☐ Invertebrates
	If yes, for what price?	Reef and lagoon fish _____ Currency/unit _____ and/or Invertebrates _____ Currency/unit _____

Conversion of local units in kg (*Information on local units may be provided by key informant(s); however, corresponding weight in kg may require sampling in the field*)

Reef and lagoon fish	Local unit	Average weight in kg

Invertebrates	Local unit	Average weight in kg

List of seasonal reef and lagoon **finfish** species usually caught

Vernacular name	Scientific name	Most abundant from (month)	Until (month)

List of seasonal reef and lagoon **invertebrate** species usually caught

Vernacular name	Scientific name	Most abundant from (month)	Until (month)

Vernacular, common and scientific names for reef and lagoon **finfish**		
Vernacular name	Common name	Scientific name

Vernacular, common and scientific names for reef and lagoon **invertebrates**		
Vernacular name	Common name	Scientific name

THANK YOU !

Annex VI

MIDDLEMEN, AGENTS, SHOP OWNERS SURVEY QUESTIONNAIRE FORM

Name: _____ **Village / Place :** _____ **Date:** _____

Middleman ☐ Shop owner ☐

Agent ☐ Other-specify: _____

List villages/communities who <u>are selling</u> to you:

_____

_____

_____

_____

List villages/communities who <u>are buying</u> from you:

_____

_____

_____

_____

What do you buy? Finfish ☐ Invertebrates ☐

FINFISH			
Species	Buy for (currency/quantity)	Sell for (currency/quantity)	Approximate quantity per month

INVERTEBRATES				
Species	Processing level	Buy for (currency/quantity)	Sell for (currency/quantity)	Approximate quantity per month

Is your demand for finfish higher than the supply? ☐

lower than the supply? ☐

Is your demand for invertebrates

Which ones? List names:	higher than the supply?	lower than the supply?
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐

Do you have any major problem with the fishers? Yes ☐ No ☐

If yes, list problems: _____

_____

_____

Do you have any major problem with your buyers? Yes ☐ No ☐

If yes, list problems: _____

_____

_____

THANK YOU!

Annex VII

SURVEY FORM AND SUMMARY FOR ADDITIONAL INFORMATION TO BE COLLECTED (input required for analysis)

The information below is a summary of outputs from Key Informant—Selected Information and/or General Information—Checklist surveys. This summary sheet is one of the major inputs for data analysis and should be provided as an attachment to the results section.

a) Marketing information on finfish and invertebrates

People sell their catch in the community	Reef and lagoon fish	
	Yes ☐ No ☐	
	Invertebrates	
	Yes ☐ No ☐	
Prices for reef and lagoon fish	Specify fish type/species if applicable:	Currency/unit
Prices for invertebrates	Specify invertebrate/name:	Currency/unit

b) Information on canned fish

Price and weight of canned fish	Size	Fish weight per can (g)	Price (local currency)
	Small		
	Medium		
	Large		

c) Exchange rate

Exchange rate		Local currency	USD
Date			

d) Conversion of local finfish units into weight (kg)

Conversion of local units for reef and lagoon fish in kg	
Local unit*	Average weight in kg

* String, heap, bag, etc.

e) Conversion of local invertebrate units into weight (kg)

Conversion of local units for invertebrates in kg			
Species name	Processing level*	Local unit**	Average weight in kg

* Processing level refers to: unprocessed (alive, such as crab or lobster), with shell or shelled, gutted (bêche-de-mer), cooked, dried, etc.

** Heap, bag, string, bottle, sack, basket, bucket, etc.

f) Seasonality of finfish species

List of seasonal reef and lagoon fish species			
Vernacular name	Scientific name	Most abundant from (month)	Until (month)

g) Seasonality of invertebrate species

List of seasonal invertebrate species			
Vernacular name	Scientific name	Most abundant from (month)	Until (month)

h) Index of vernacular names—Finfish

Index of vernacular/scientific reef and lagoon fish names		
Vernacular name	**Common name(s)**	**Scientific name(s)**

i) Index of vernacular names—Invertebrates

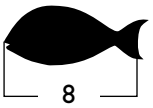
Index of vernacular/scientific reef and lagoon fish names		
Vernacular name	**Common name(s)**	**Scientific name(s)**

Annex VIII

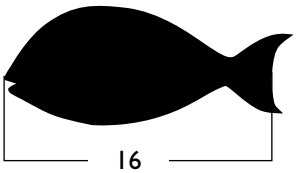
FISH SIZE CHARTS

Overview of five fish size classes used for estimating average finfish sizes caught and/or consumed (length is given in fork length).

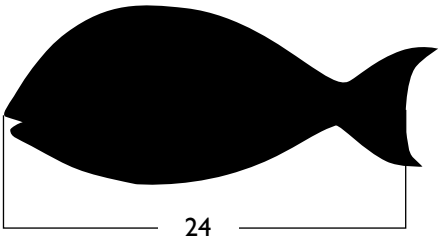
Fish size A



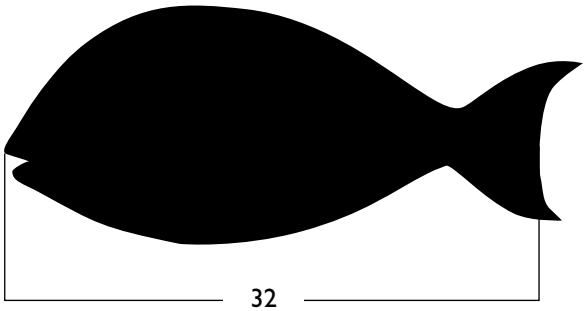
Fish size B



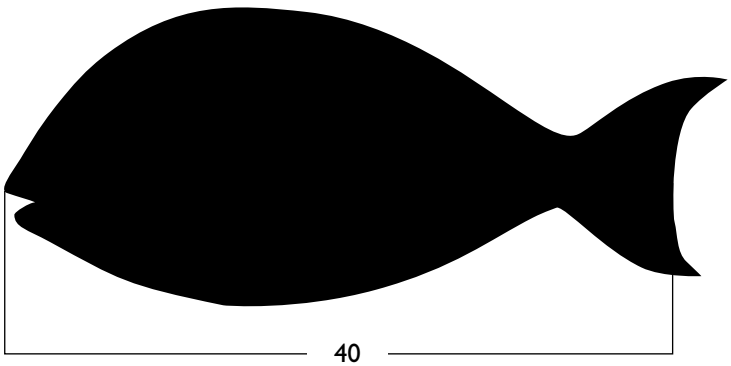
Fish size C



Fish size D



Fish size E

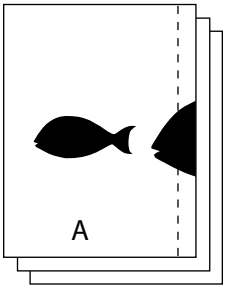


Fork length (cm)

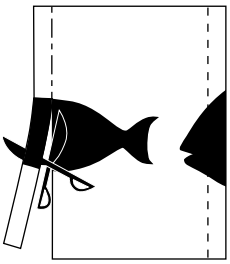
Fork length measures the length of the fish from the tip of the longest jaw or the end of the snout to the longest caudal lobe.

Instructions for making a fish size chart

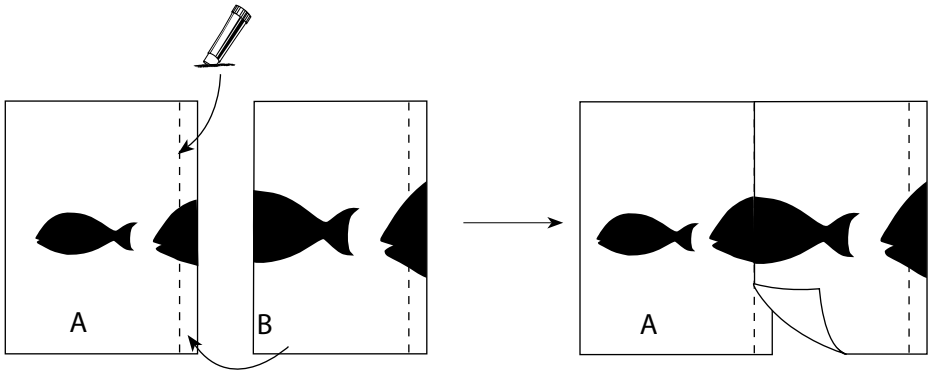
Step 1: Photocopy the pages.



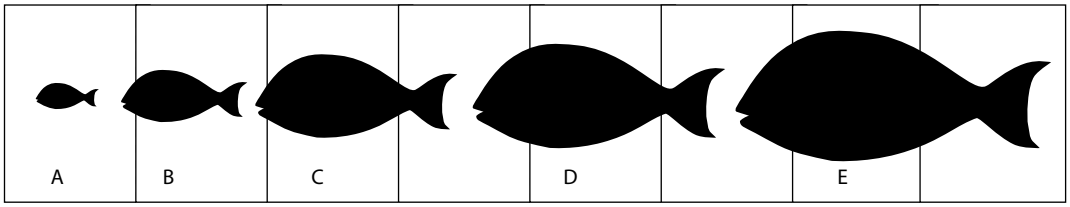
Step 2: Cut paper along the line



Step 3: Glue the next pages so they overlap as shown.



Sample of a completed fish size chart

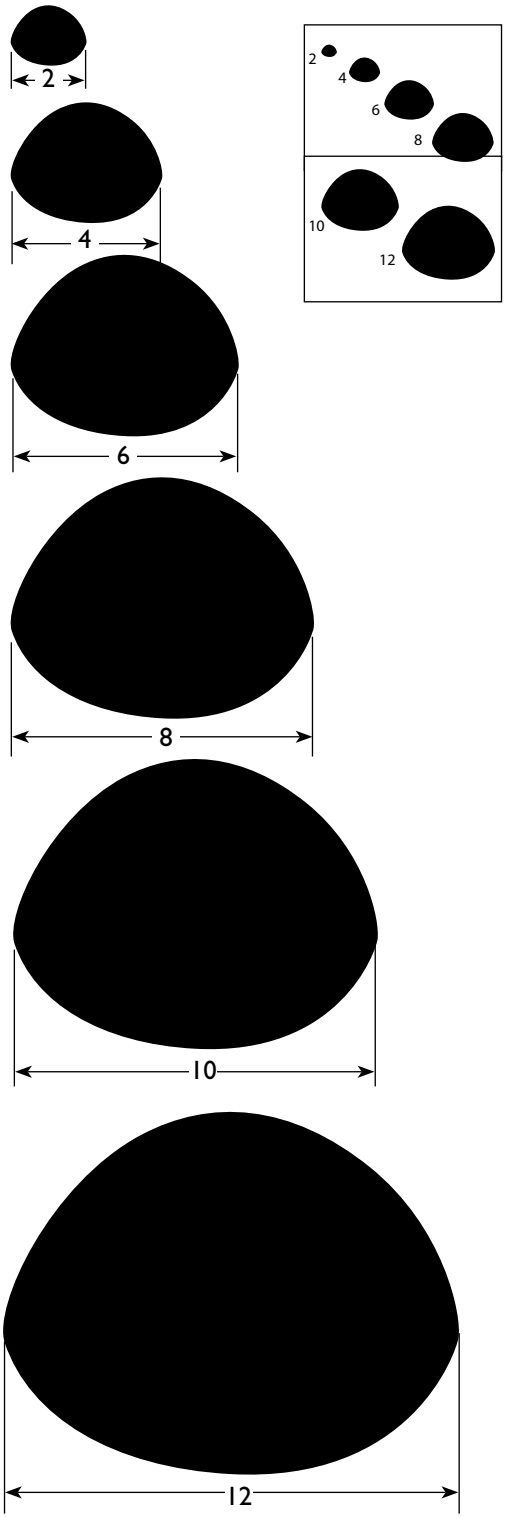


Annex IX

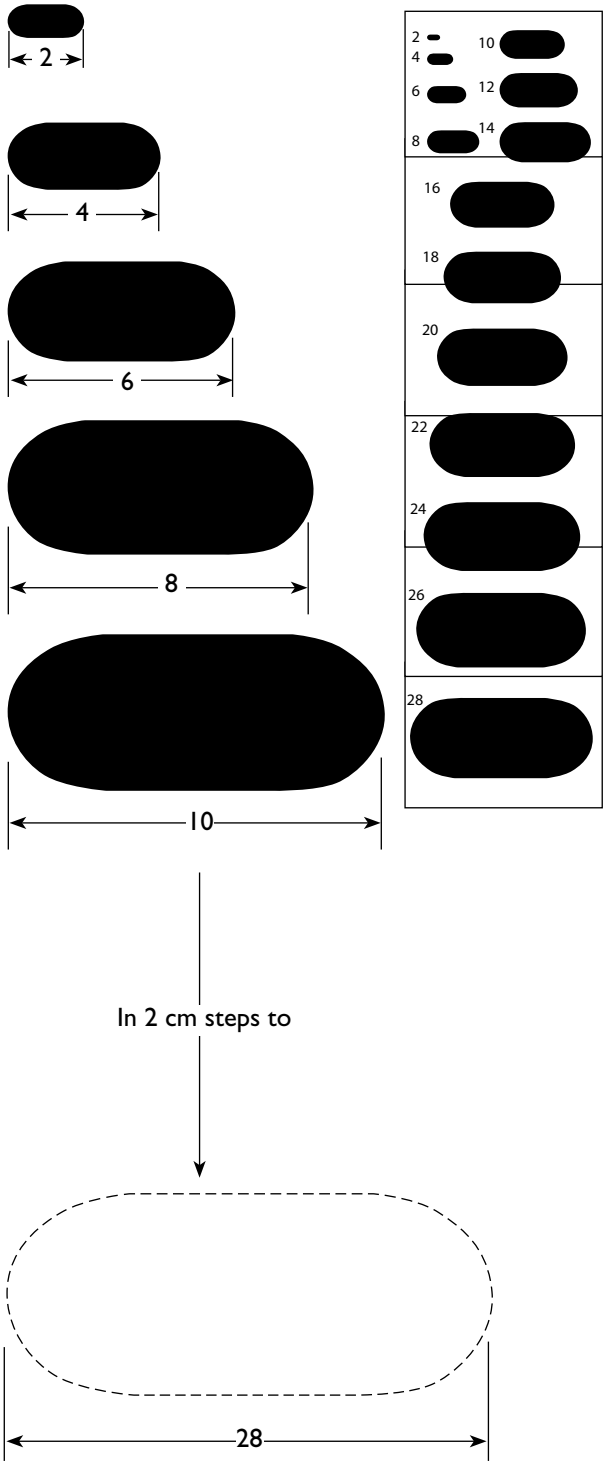
INVERTEBRATE SIZE CHARTS

Overview of selected invertebrate size classes used for estimating average invertebrate sizes caught and/or consumed (length is given in cm).

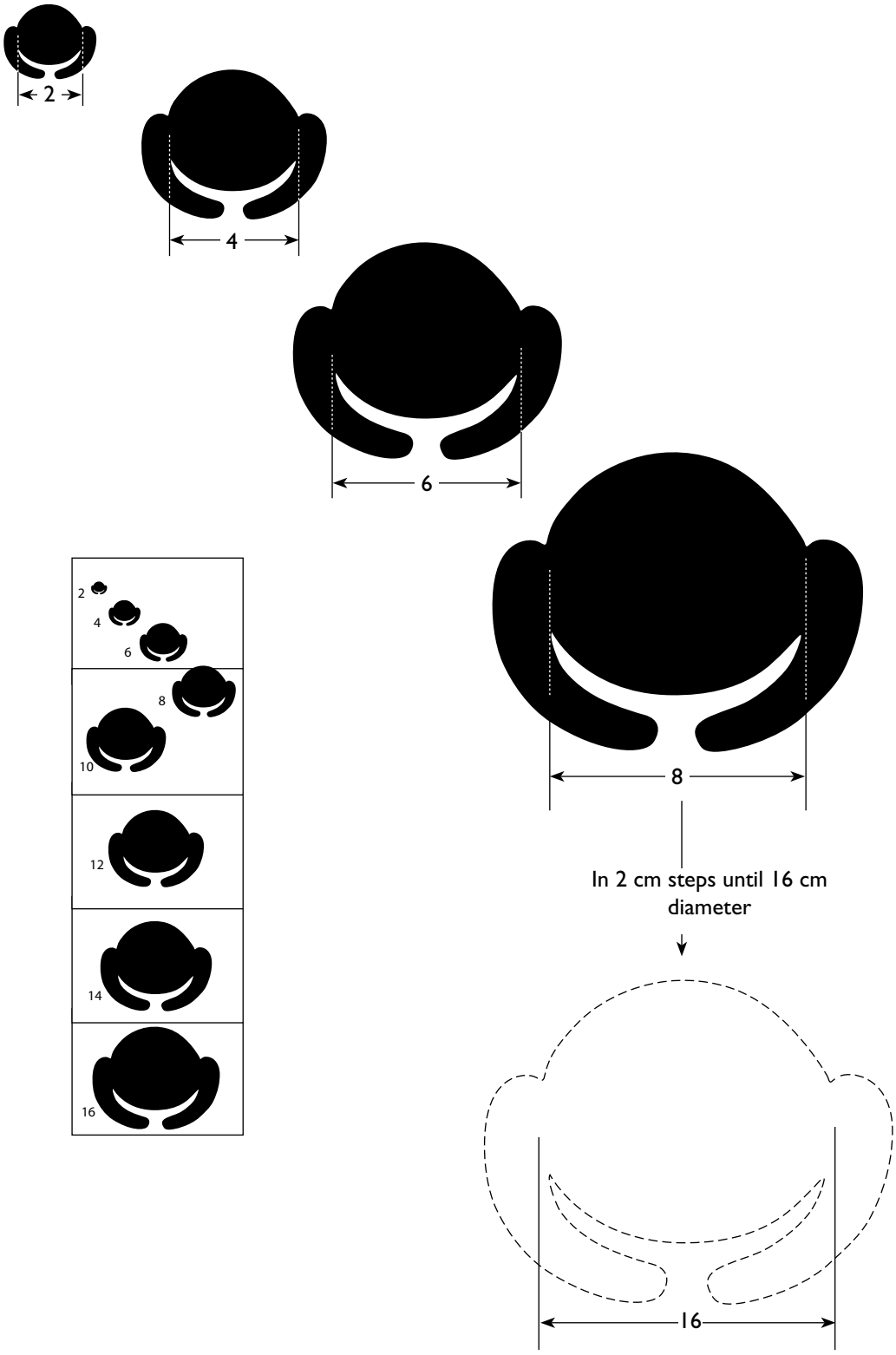
For bivalves, molluscs, sea urchins, trochus, and octopus head diameters

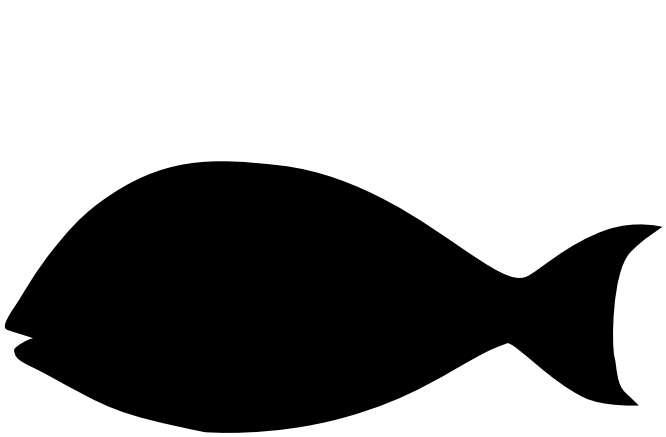


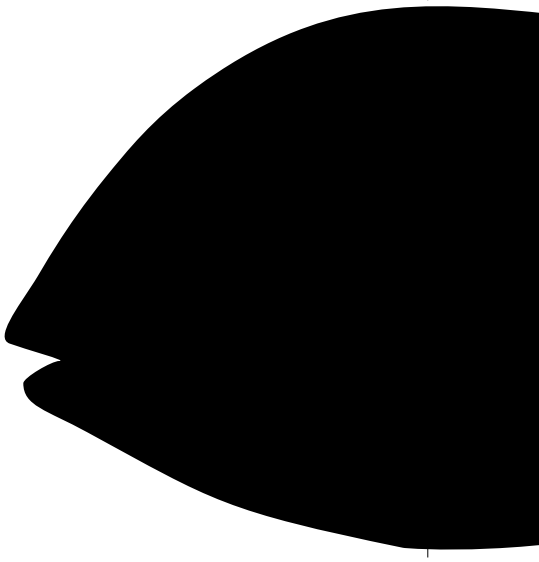
For bêche-de-mer, giant clams and lobsters (note: for lobsters don't count length of antennae)



For crabs from all kinds of environments

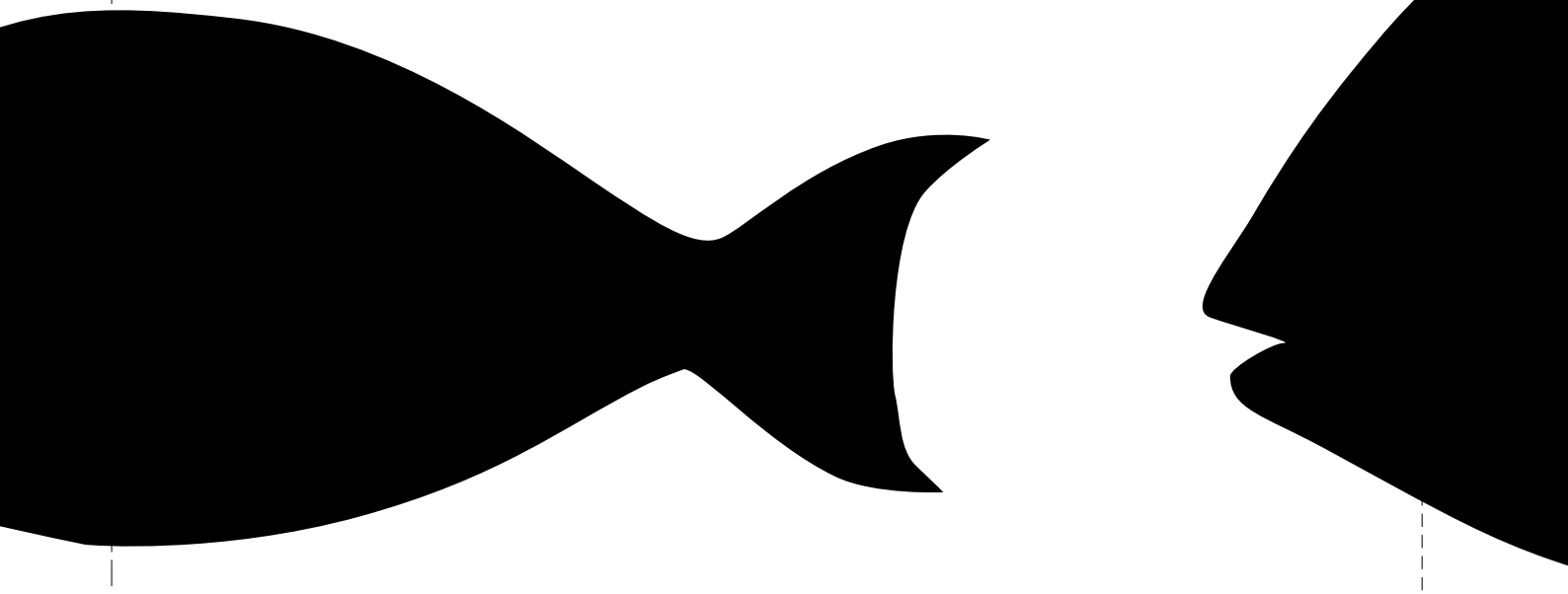




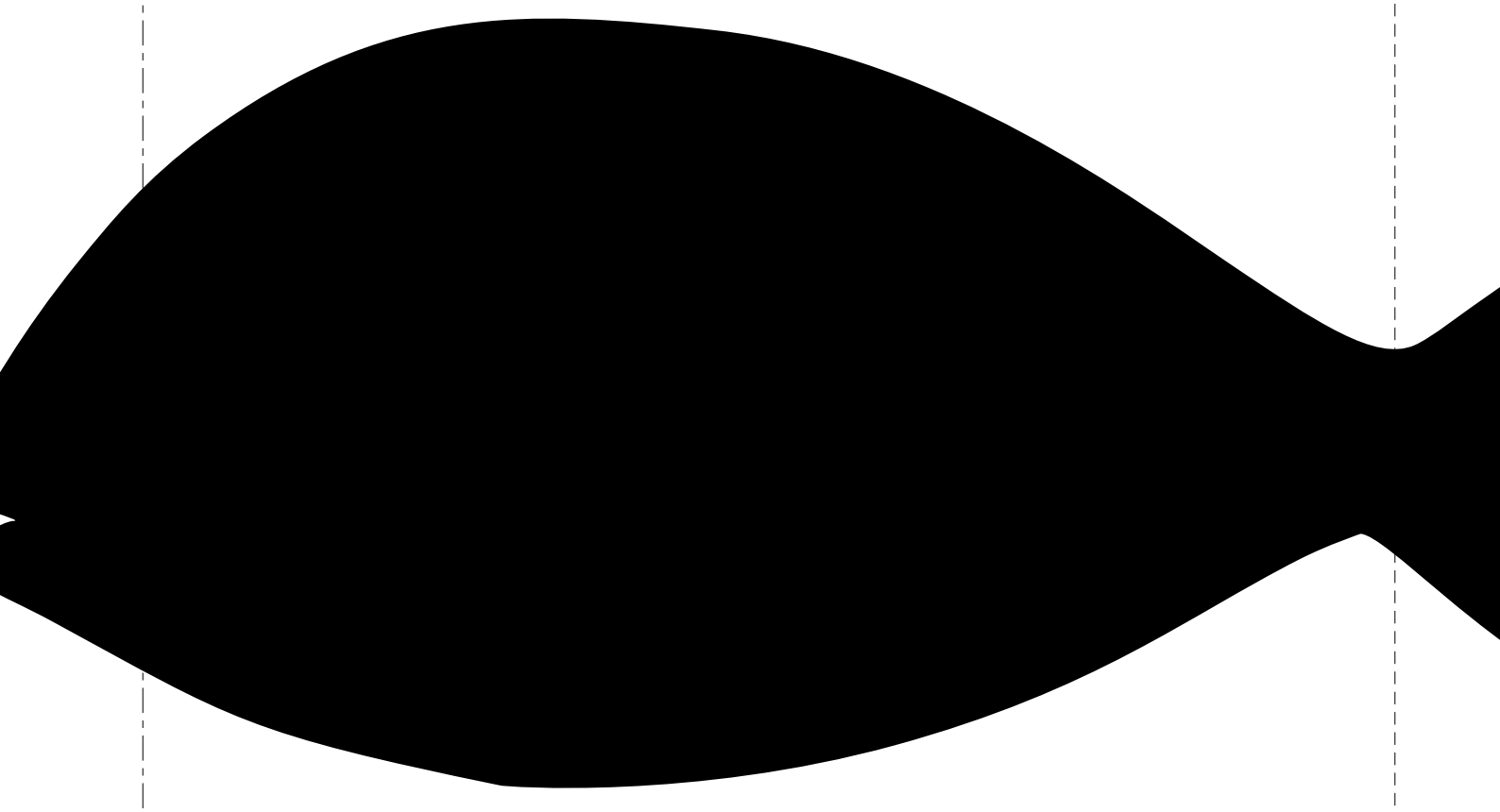


A

B



B



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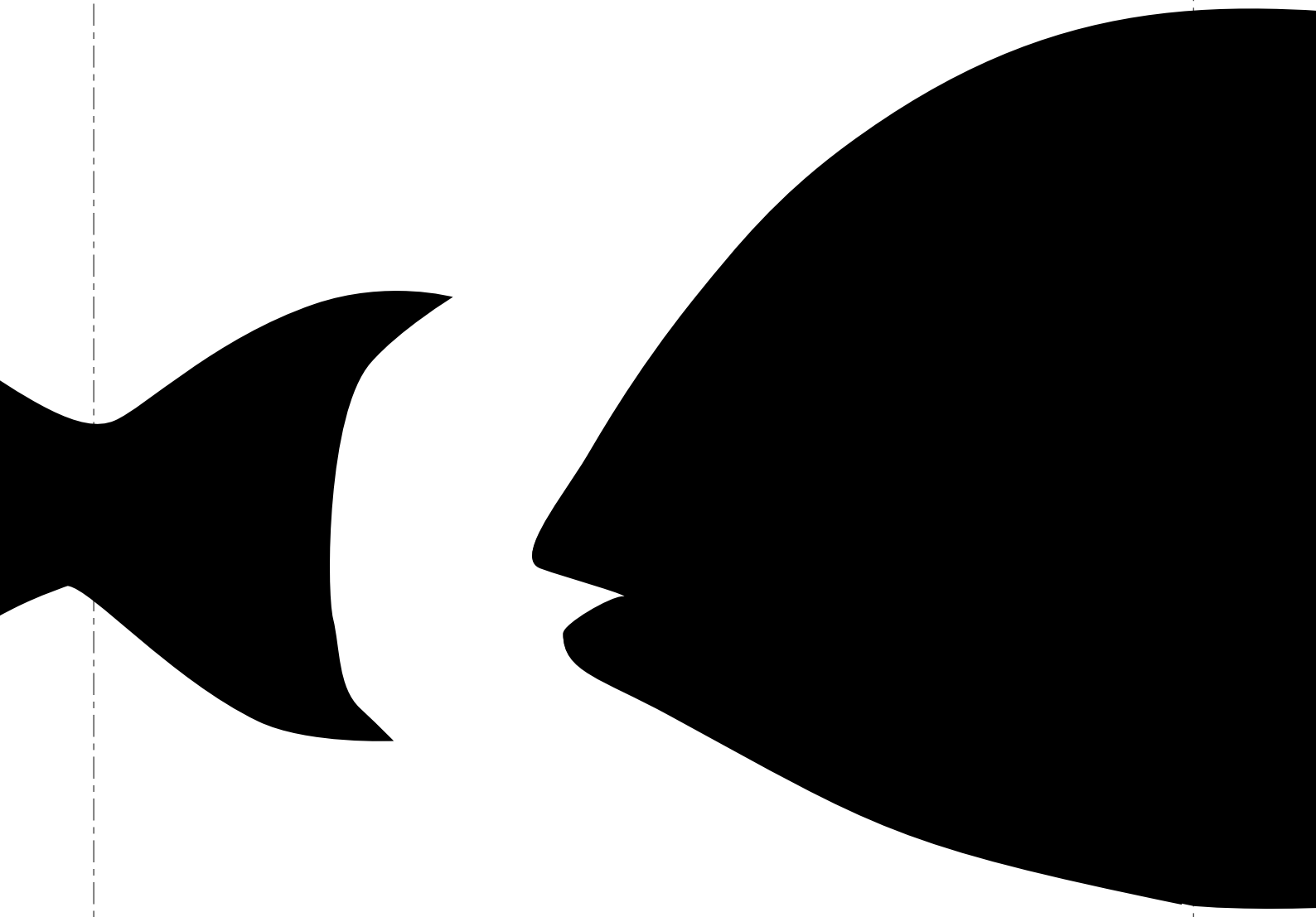

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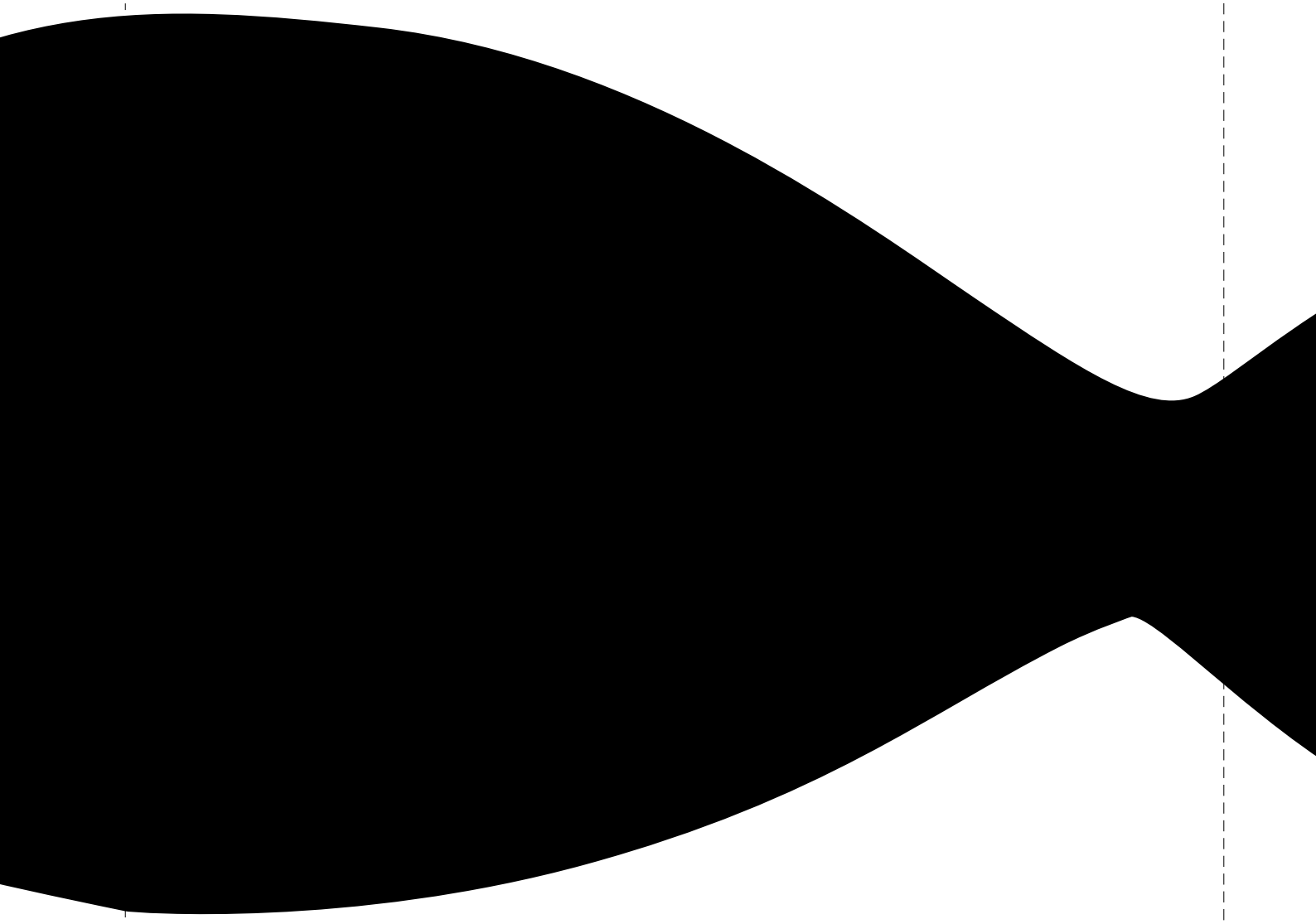

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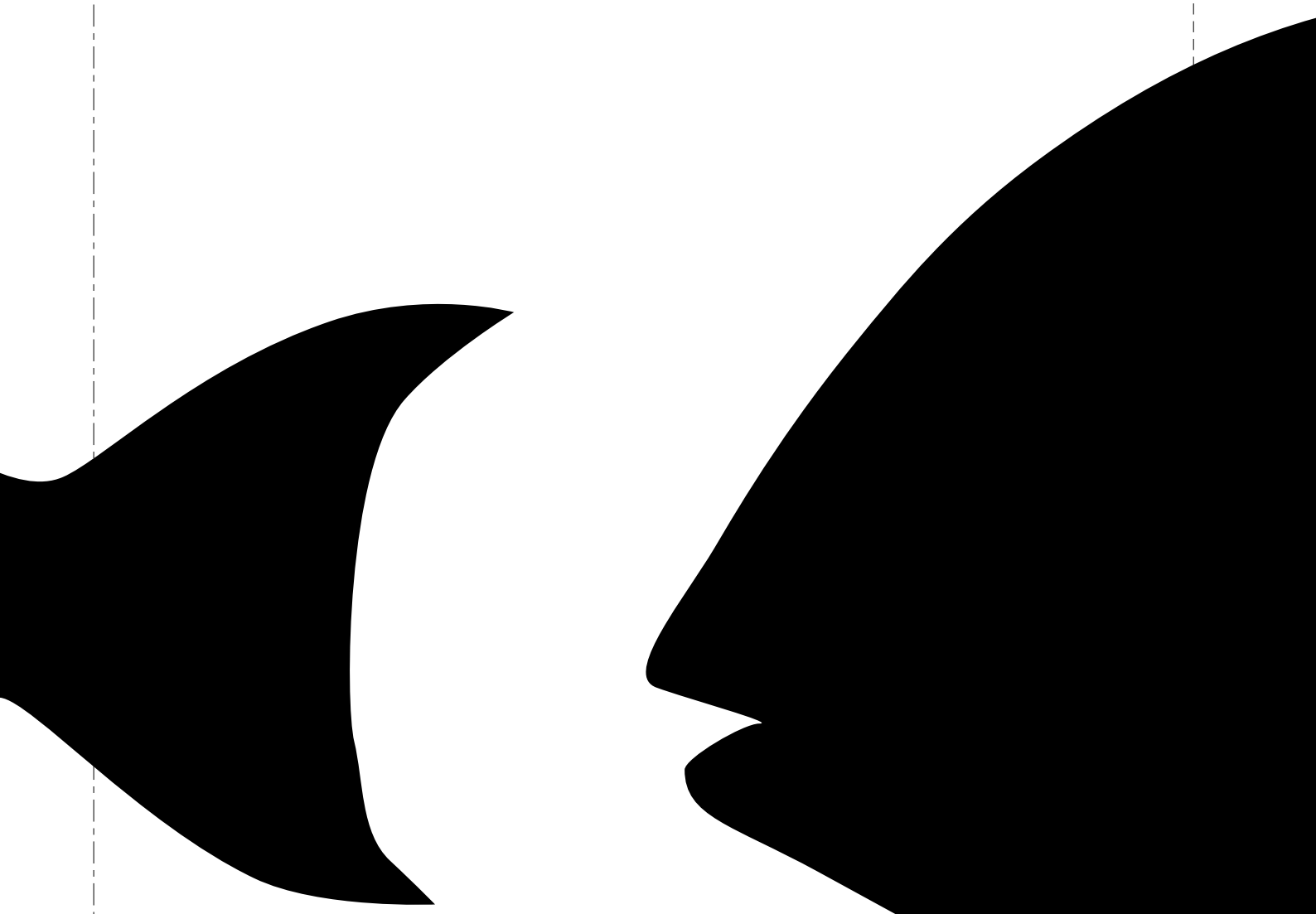

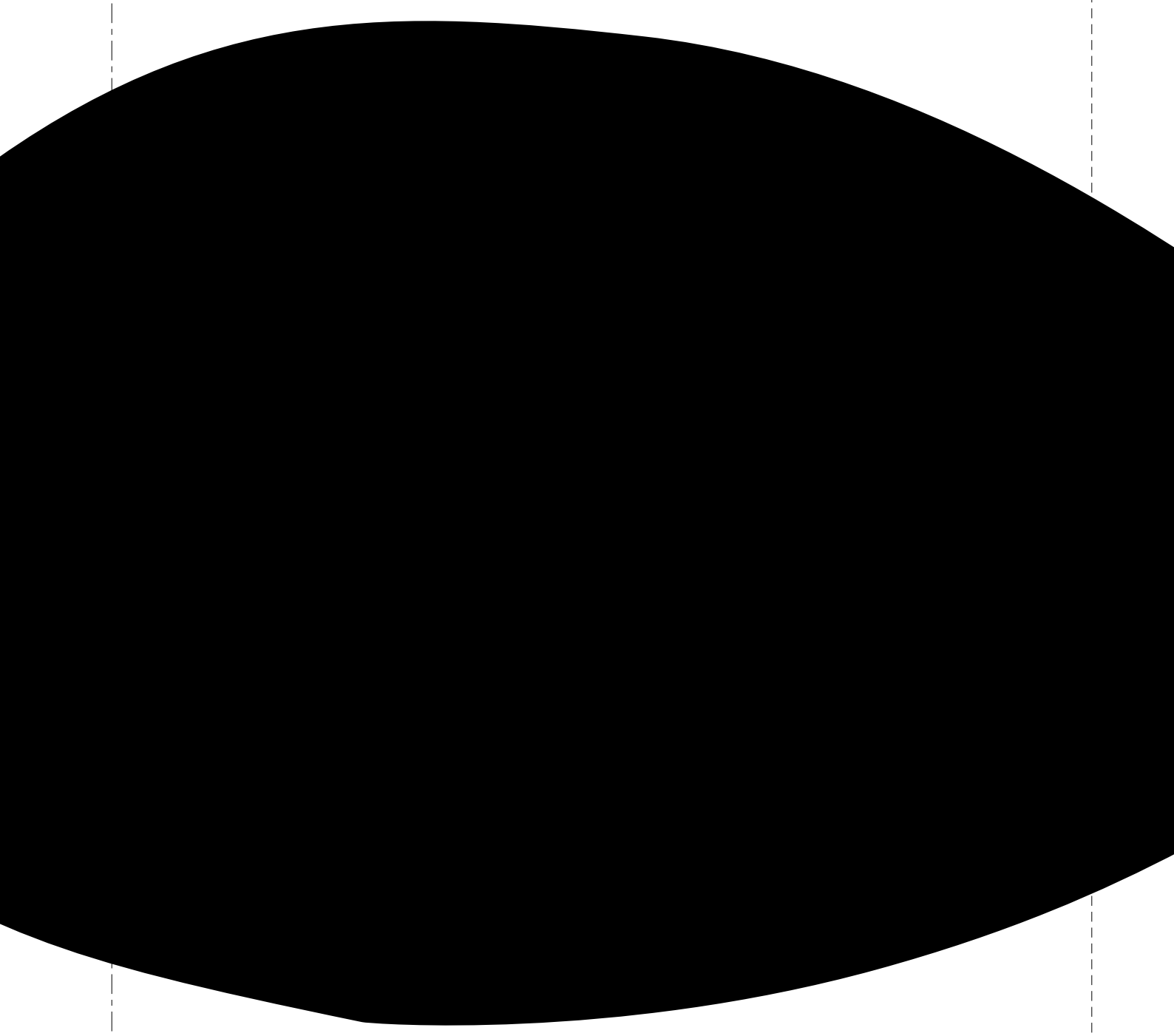

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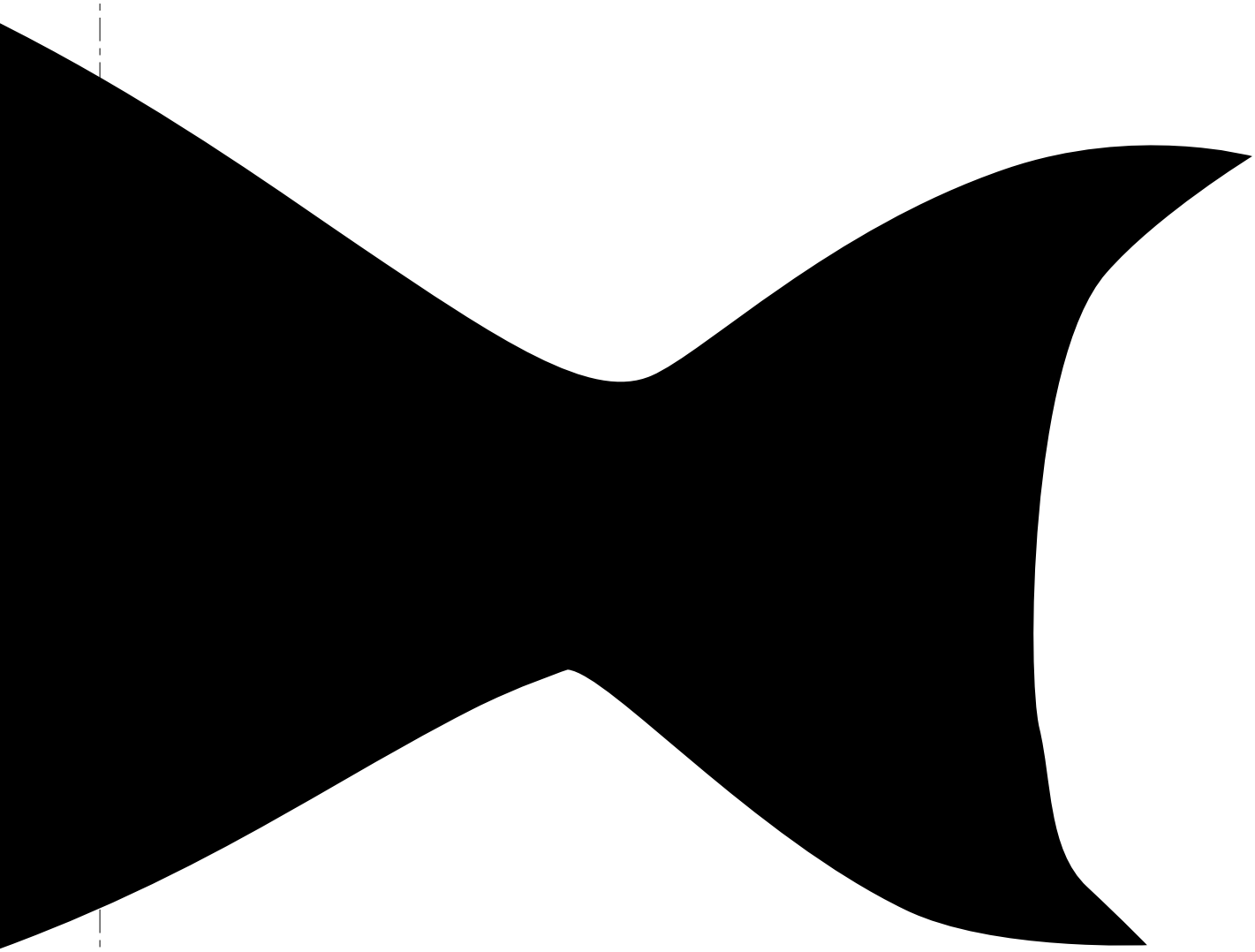

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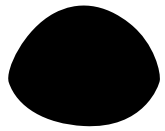

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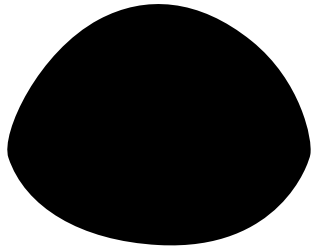

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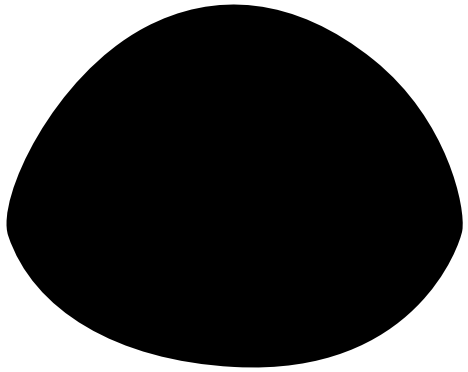

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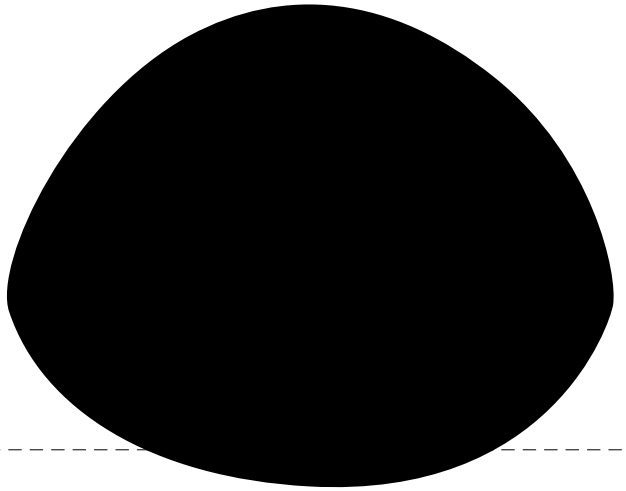

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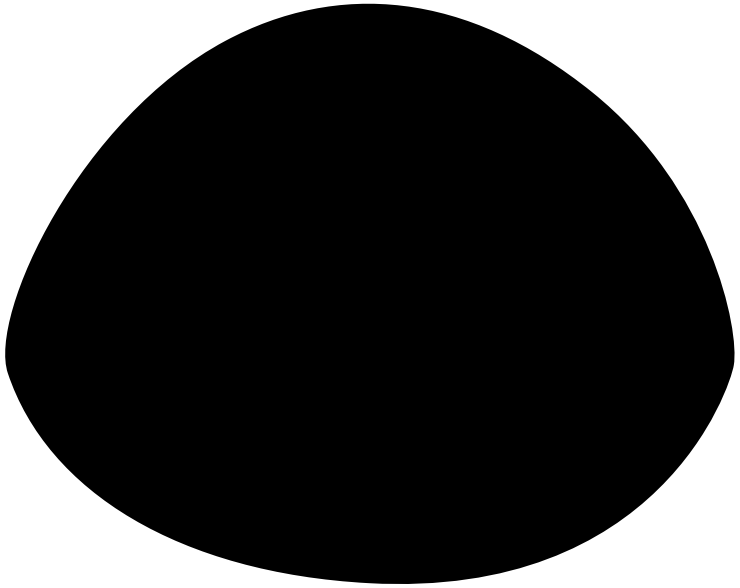

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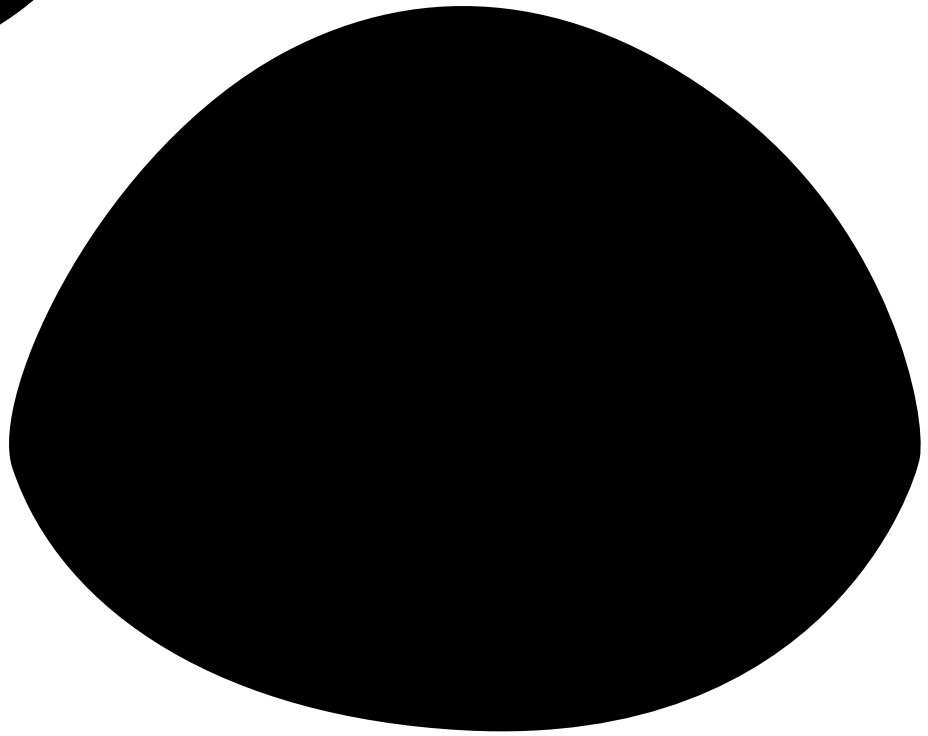


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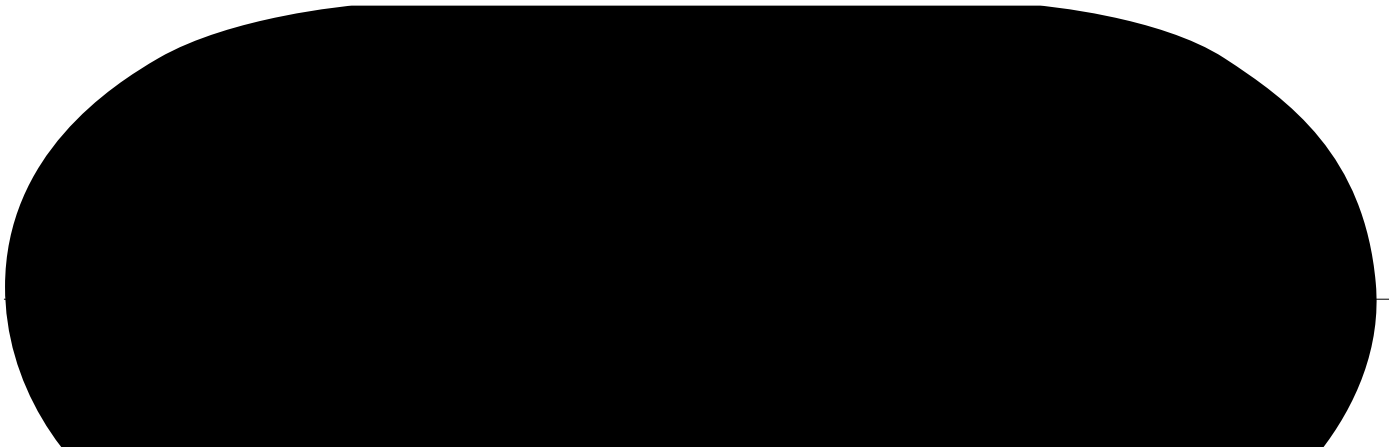

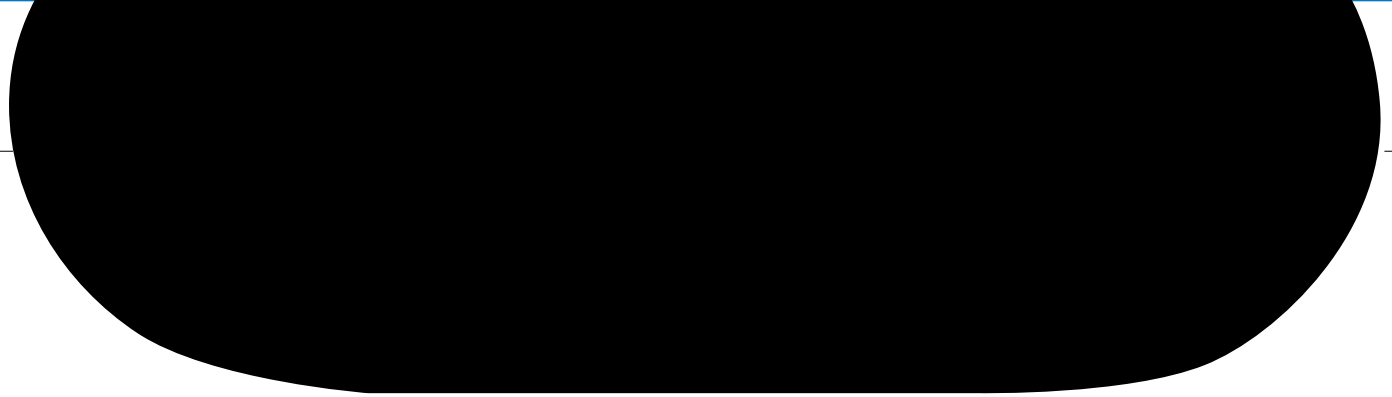

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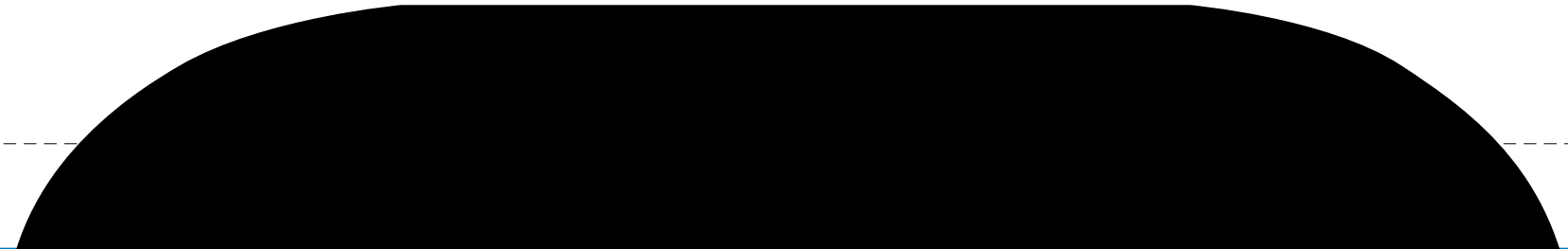

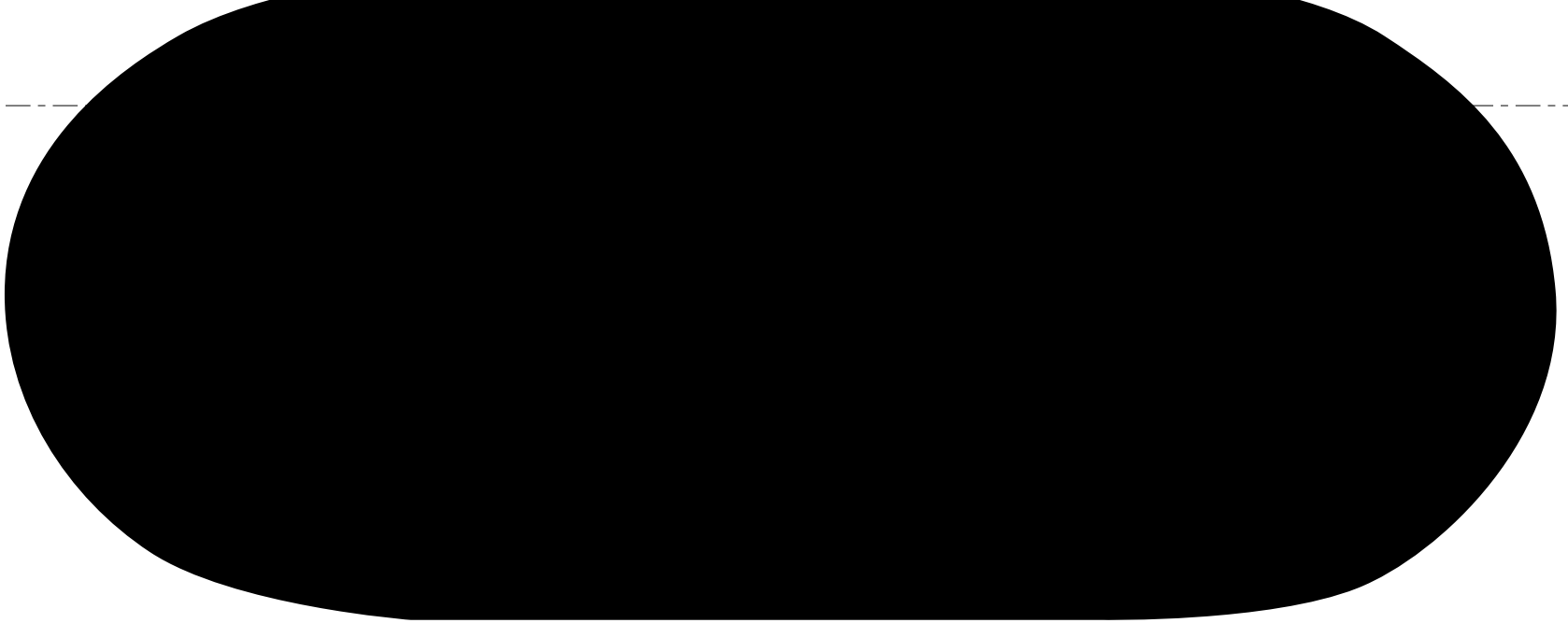

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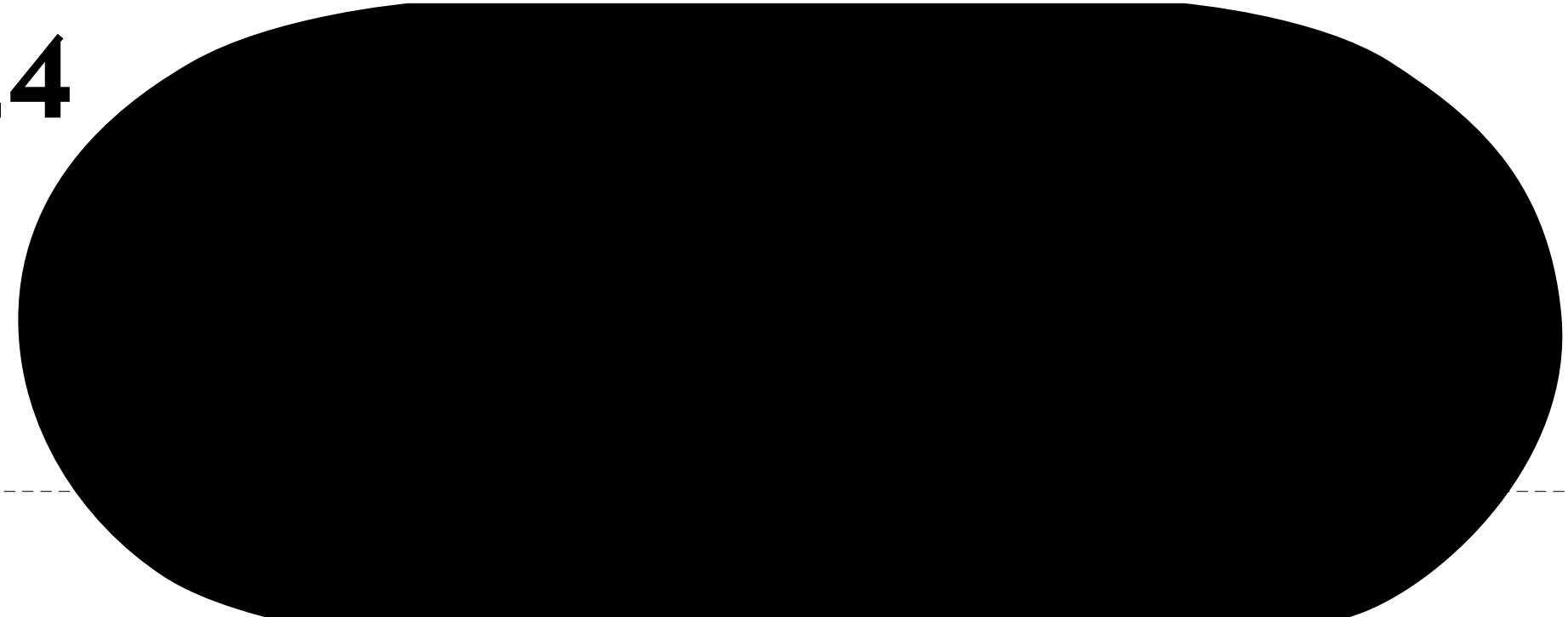

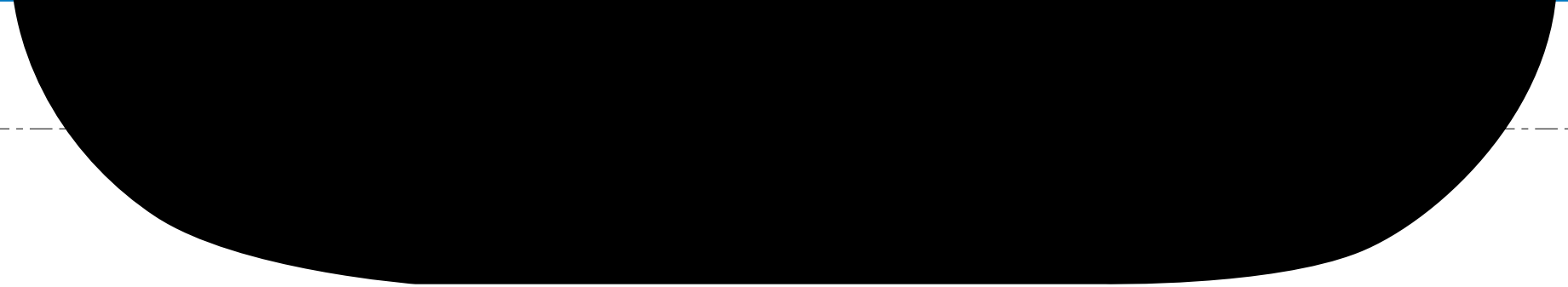

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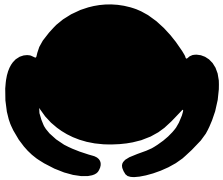

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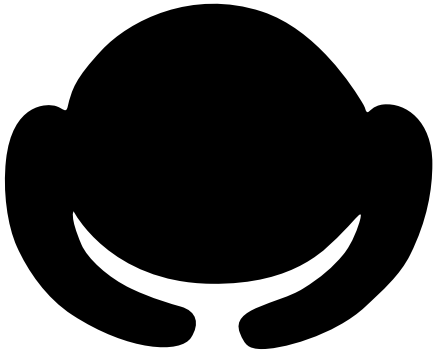

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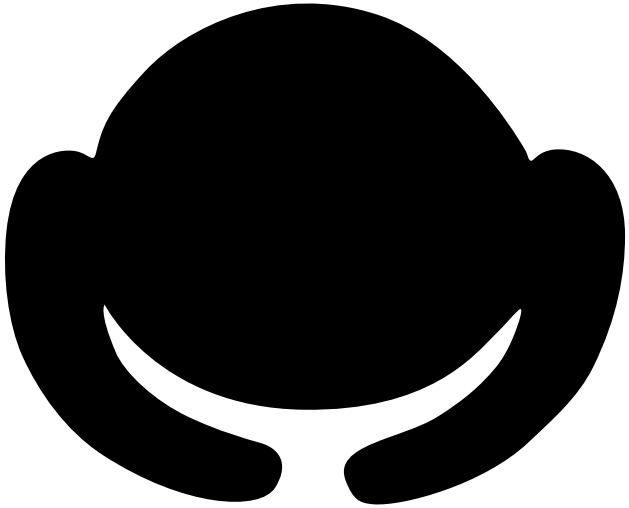

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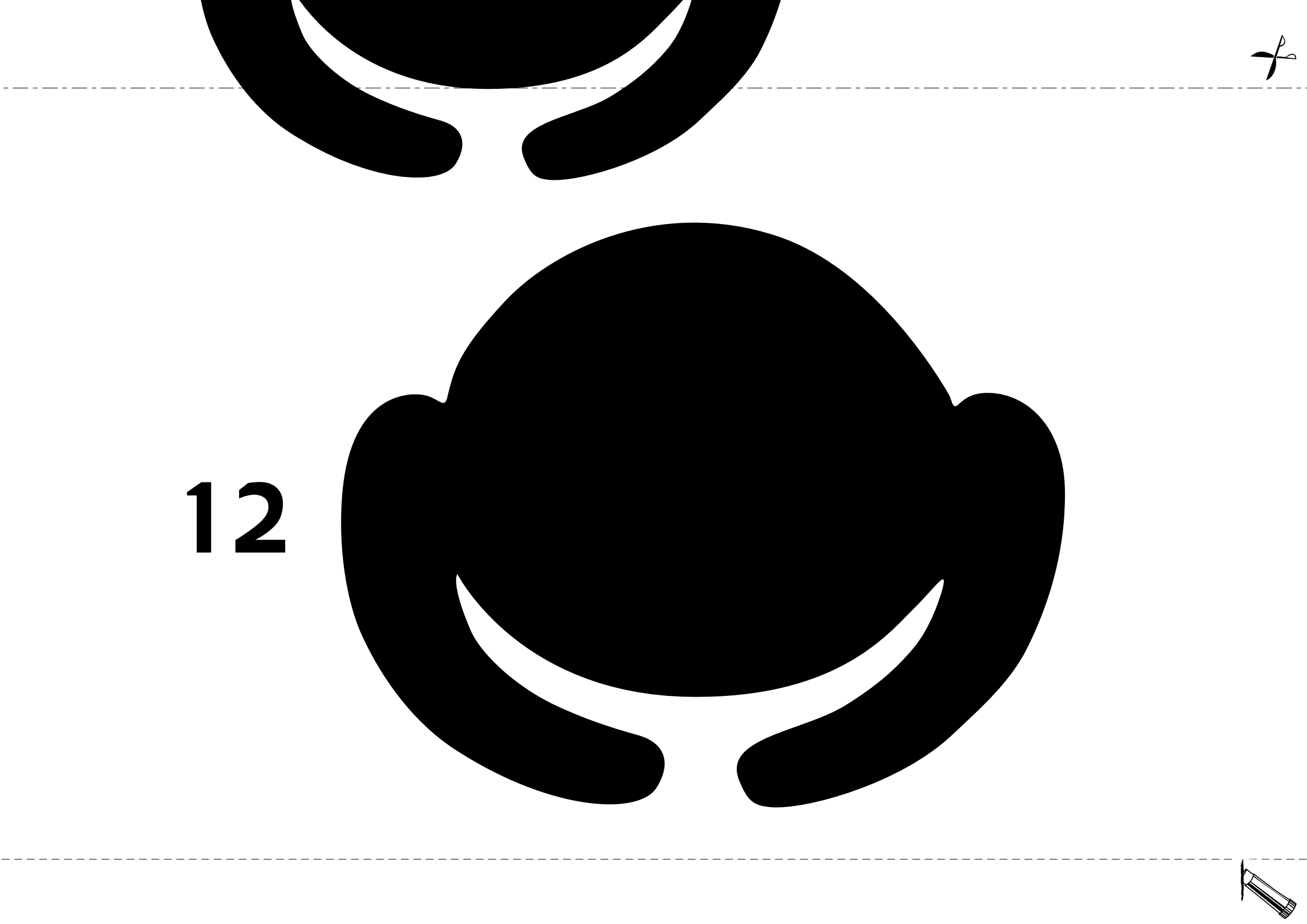
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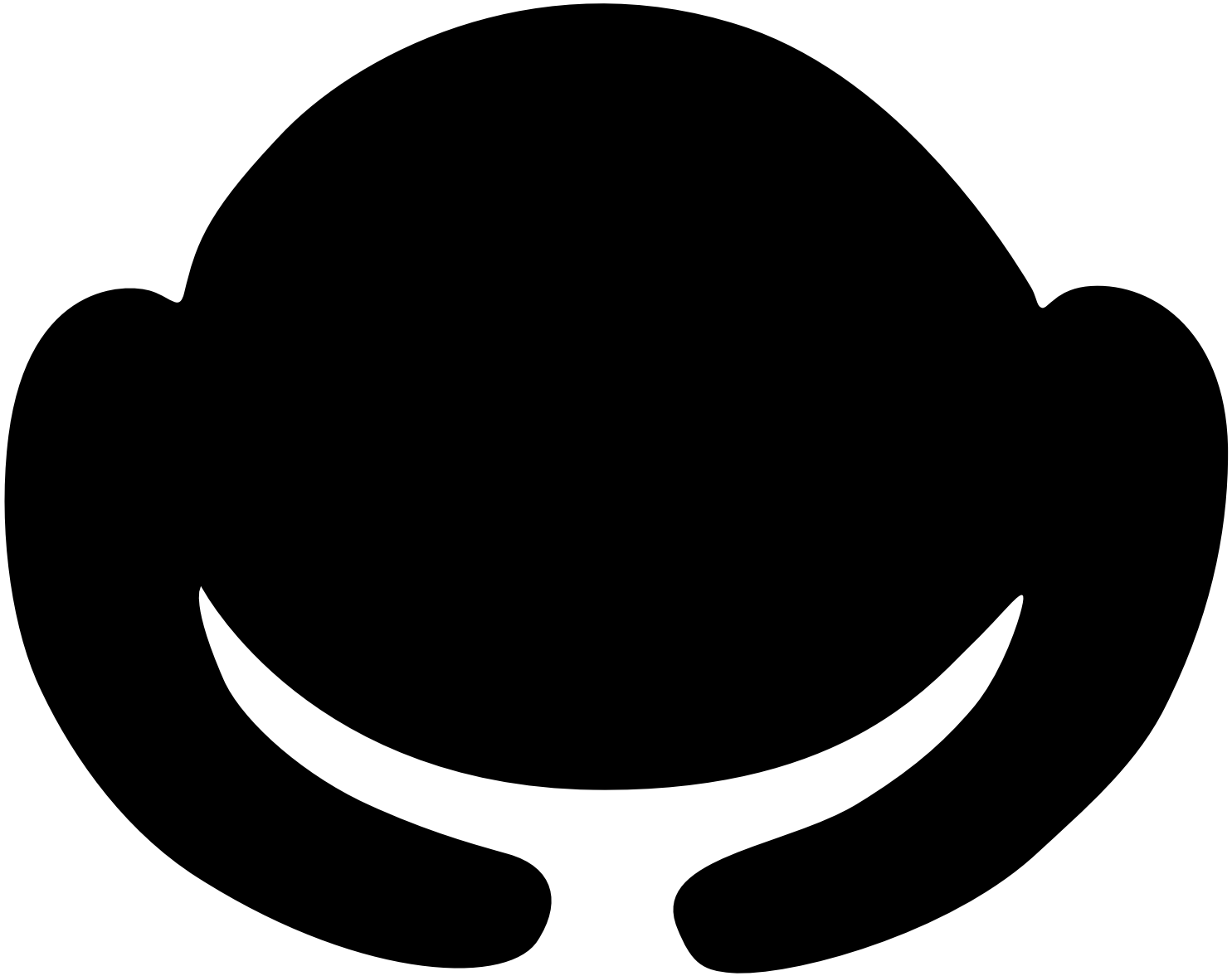

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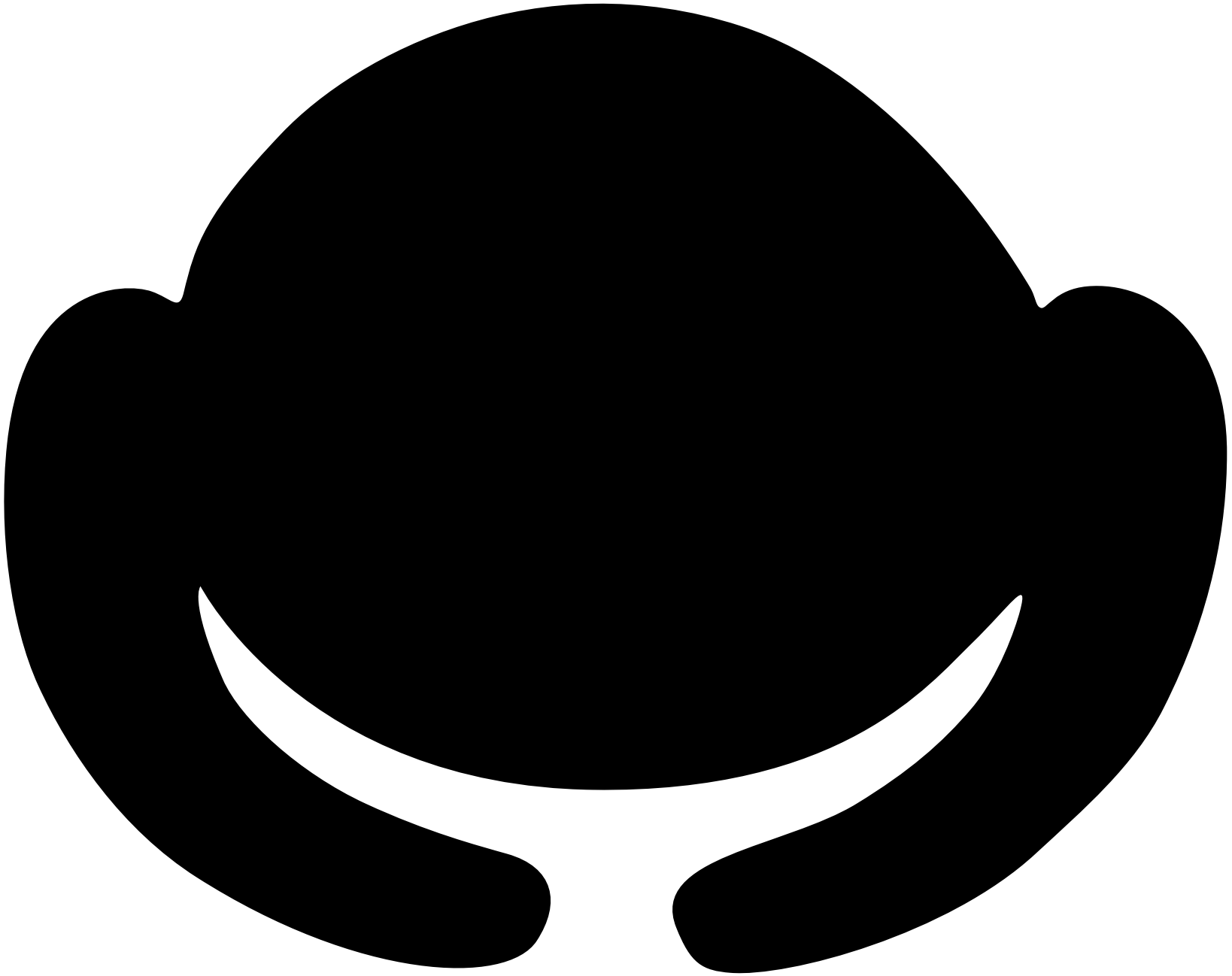

Annex X

STATISTICAL TERMINOLOGY: SIMPLE TESTS FOR DATA RELIABILITY, PATTERNS WITHIN DATASETS ANALYSED

Simple tests for data reliability can be easily performed using, for example, the insert function (statistics) in the Excel software package.

The mean

The **mean** is the average and is computed as the sum of all observed outcomes from the sample divided by the total number of events.

For example: We have surveyed 6 households with the following numbers of people

Household	Total number of people
1	6
2	8
3	2
4	1
5	10
6	12
	39

This means that we have a total of 39 people in 6 households, or a mean or an average of 6.5 people per household.

This average of 6.5 people per household does not tell us about the range of household sizes surveyed.

We can use the **minimum–maximum** values to show the range of values represented in any dataset.

In our example, that would be 1 for the minimum household size, and 12 for the maximum household size.

In addition we could use the **median**. The median is the number in the middle of a set of numbers. So the median shows the threshold where half of all numbers have values smaller and half of all numbers have values greater than the median.

In our example of the 6 households, the median is 7, meaning that 3 households have less than 7 people (1, 2 , 6) and 3 households have more than 7 people (8, 10, 12).

In statistical practice, the **standard deviation** is the most-used measure of spread. This means that the standard deviation measures how far individual values spread around the mean (average). Because of its close links with the mean, standard deviation can be greatly affected if the mean gives a poor measure of central tendency. Generally speaking, the more widely spread the values are, the larger the standard deviation is.

Standard deviation is calculated as follows:

$$S^2 = \sqrt{\frac{1}{n-1}} \sum_{i=1}^{n} (x_i - \bar{x})^2$$

For our household size dataset, the standard deviation is 4.370355.

Annex XI

PROPOSED UNIT WEIGHTS FOR INVERTEBRATE SPECIES AND SPECIES GROUPS

(Source: PROCFish/C project. Note: assumed unit weights are subject to change)

Scientific name	g/piece	% edible part	% non-edible part	Edible part g/piece	Group
Acanthopleura gemmata	29	35	65	10.15	Chiton
Actinopyga lecanora	300	10	90	30	BdM*
Actinopyga mauritiana	350	10	90	35	BdM*
Actinopyga miliaris	300	10	90	30	BdM*
Anadara spp.	21	35	65	7.35	Bivalve
Asaphis violascens	15	35	65	5.25	Bivalve
Astralium spp.	20	25	75	5	Gastropod
Atactodea striata, Donax cuneatus	2.7	35	65	0.96	Bivalve
Atrina vexillum, Pinctada margaritifera	225	35	65	78.75	Bivalve
Birgus latro	1000	35	65	350	Crustacean
Bohadschia argus	462.5	10	90	46.25	BdM*
Bohadschia spp.	462.5	10	90	46.25	BdM*
Bohadschia vitiensis	462.5	10	90	46.25	BdM*
Cardisoma carnifex	227.8	35	65	79.74	Crustacean
Carpilius maculatus	350	35	65	122.5	Crustacean
Cassis cornuta, Thais aculeata	20	25	75	5	Gastropod
Cerithium nodulosum	240	25	75	60	Gastropod
Chama spp.	25	35	65	8.75	Bivalve
Codakia punctata	20	35	65	7	Bivalve
Coenobita spp.	50	35	65	17.5	Crustacean
Conus miles, Strombus gibberulus gibbosus	240	25	75	60	Gastropod
Conus spp.	240	25	75	60	Gastropod
Cypraea annulus, C. moneta	10	25	75	2.5	Gastropod
Cypraea caputserpensis	15	25	75	3.75	Gastropod
Cypraea mauritiana	20	25	75	5	Gastropod
Cypraea spp.	95	25	75	23.75	Gastropod
Cypraea tigris	95	25	75	23.75	Gastropod
Dardanus spp.	10	35	65	3.5	Crustacean
Dendropoma maximum	15	25	75	3.75	Gastropod
Diadema spp.	50	48	52	24	Echinoderm
Dolabella auricularia	35	50	50	17.5	Other
Donax cuneatus	15	35	65	5.25	Bivalve

Scientific name	g/piece	% edible part	% non-edible part	Edible part g/piece	Group
Drupa spp.	20	25	75	5	Gastropod
Echinometra mathaei	50	48	52	24	Echinoderm
Echinothrix spp.	100	48	52	48	Echinoderm
Eriphia sebana	35	35	65	12.25	Crustacean
Gafrarium pectinatum	21	35	65	7.35	Bivalve
Gafrarium tumidum	21	35	65	7.35	Bivalve
Grapsus albolineatus	35	35	65	12.25	Crustacean
Hippopus hippopus	35	19	81	6.65	Giant clam
Holothuria atra	100	10	90	10	BdM*
Holothuria coluber	100	10	90	10	BdM*
Holothuria fuscogilva	2000	10	90	200	BdM*
Holothuria fuscopunctata	1800	10	90	180	BdM*
Holothuria nobilis	2000	10	90	200	BdM*
Holothuria scabra	2000	10	90	200	BdM*
Holothuria spp.	2000	10	90	200	BdM*
Lambis lambis	25	25	75	6.25	Gastropod
Lambis spp.	25	25	75	6.25	Gastropod
Lambis truncata	500	25	75	125	Gastropod
Mammilla melanostoma, Polinices mammilla	10	25	75	2.5	Gastropod
Modiolus auriculatus	21	35	65	7.35	Bivalve
Nerita albicilla, N. polita	5	25	75	1.25	Gastropod
Nerita plicata	5	25	75	1.25	Gastropod
Nerita polita	5	25	75	1.25	Gastropod
Octopus spp.	550	90	10	495	Octopus
Panulirus ornatus	1000	35	65	350	Crustacean
Panulirus penicillatus	1000	35	65	350	Crustacean
Panulirus spp.	1000	35	65	350	Crustacean
Panulirus versicolor	1000	35	65	350	Crustacean
Parribacus antarcticus	750	35	65	262.5	Crustacean
Parribacus caledonicus	750	35	65	262.5	Crustacean
Patella flexuosa	15	35	65	5.25	Limpet
Periglypta puerpera, P. reticulate	15	35	65	5.25	Bivalve
Periglypta spp., *Spondylus* spp.	15	35	65	5.25	Bivalve
Pinctada margaritifera	200	35	65	70	Bivalve
Pitar proha	15	35	65	5.25	Bivalve
Planaxis sulcatus	15	25	75	3.75	Gastropod
Pleuroploca filamentosa	150	25	75	37.5	Gastropod
Pleuroploca trapezium	150	25	75	37.5	Gastropod
Portunus pelagicus	227.8	35	65	79.74	Crustacean

Scientific name	g/piece	% edible part	% non-edible part	Edible part g/piece	Group
Saccostrea cucullata	35	35	65	12.25	Bivalve
Saccostrea spp.	35	35	65	12.25	Bivalve
Scylla serrata	700	35	65	245	Crustacean
Serpulorbis spp.	5	25	75	1.25	Gastropod
Sipunculus indicus	50	10	90	5	Seaworm
Spondylus squamosus	40	35	65	14	Bivalve
Stichopus chloronotus	100	10	90	10	BdM*
Stichopus spp.	543	10	90	54.3	BdM*
Strombus gibberulus gibbosus	25	25	75	6.25	Gastropod
Strombus luhuanus	25	25	75	6.25	Gastropod
Tapes literatus	20	35	65	7	Bivalve
Tectus pyramis, Trochus niloticus	300	25	75	75	Gastropod
Tellina palatum	21	35	65	7.35	Bivalve
Tellina spp.	20	35	65	7	Bivalve
Terebra spp.	37.5	25	75	9.39	Gastropod
Thais armigera	20	25	75	5	Gastropod
Thais spp.	20	25	75	5	Gastropod
Thelenota ananas	2500	10	90	250	BdM*
Thelenota anax	2000	10	90	200	BdM*
Tridacna maxima	500	19	81	95	Giant clam
Tridacna spp.	500	19	81	95	Giant clam
Trochus niloticus	200	25	75	50	Gastropod
Turbo crassus	80	25	75	20	Gastropod
Turbo marmoratus	20	25	75	5	Gastropod
Turbo setosus	20	25	75	5	Gastropod
Turbo spp.	20	25	75	5	Gastropod

BdM = Bêche-de-mer

* Edible part of dried bêche-de-mer, i.e. drying process consumes about 90% of total wet weight, hence only 10% is considered edible

Annex XII

PER CAPITA CONSUMPTION CALCULATIONS: AGE–GENDER CORRECTIONS

To determine per capita consumption simply by dividing total household fish consumption by the number of household members results in underestimating per head consumption. This is particularly important if the per head consumption figure will be extrapolated to determine the total consumption of a much larger community than that surveyed. The need to correct for gender and age group if determining per-capita consumption becomes clear if one thinks of the proportion eaten by a small child of 5 years as compared to that eaten by the 45-year-old male head of a household.

Research was undertaken (Kronen et al. 2006) to simplify the internationally acknowledged WHO system (Becker and Helsing 1991). We obtained four age–gender correction factors.

The following example highlights how easily per-capita consumption can be underestimated if no age–gender correction system is applied:

Household 1:	Man	43 years
	Woman	39 years
	Grandmother	65 years
	Daughter 1	21 years
	Daughter 2	10 years
	Son 1	5 years
	Son 2	13 years

Total no. of people = 7

Per age–gender correction group:

< 5 years	1
6–11 years	1
12–13 years males, males 60+, all females 12+ years	4
14–59 years males	1

Total annual household consumption: 96 kg

Average per capita consumption kg/year: 96 kg/7 people = 13.7 kg per capita/year

96 kg: ((1*0.3) + (1*0.6) + (1*0.8) + (1*1) + (3*0.8)) = 19.2 kg/per capita/year

Application of correction factors proportional to gender–age groups takes into account inequities of consumption data among household members and, if applied at the village level, reflects a community's demographic characteristics. Simply dividing household consumption by the number of household members results in considerable underestimation.

Annex XIII
AVERAGE PER CAPITA FINFISH CONSUMPTION FIGURES: SOURCES

Source	Country/site	Finfish consumption kg/per capita/year
Dalzell et al. 1996[1]	Melanesian islands	7–40
Dalzell et al. 1996[1]	Polynesian islands	6–121
Dalzell et al. 1996[1]	Micronesian islands	4–170
Diverse[2]	New Caledonia	23–50
David 1991[3]	Vanuatu	22.8–23.7
Gillett 1997[4]	Vanuatu	27
Diverse[5], Gillett 1997[4]	Fiji	30–41.2
Ulaiwi 1992[6] and Gillett 1997[4]	Papua New Guinea	16.9–18.4
Gillett 1997[4]	Solomon Islands	44.8

[1] Dalzell P., Adams, T.J.H. and Polunin, N.V.C. 1996. Coastal fisheries in the Pacific Islands. Oceanography and Marine Biology: An Annual Review 34:395–531.

[2] Diverse: Labrosse, P., Ferraris, J. and Letourneur, Y. (in preparation) Estimating lagoon subsistence fisheries through fish consumption in a tropical island setting: A case study of the Northern Province of New Caledonia (Western Pacific).

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[3] David, G. 1991. Pêche villageoise et alimentation au Vanuatu: Exploration d'un système. Thèse de Doctorat de Géographie de la Mer. Université de Bretagne Occidentale, 915 p.

[4] Gillett, R. 1997. The importance of tuna to Pacific Island countries. Forum Fisheries Agency report, 33 p.

[5] Diverse: Bayliss-Smith, T. 1975. The price of protein: Marine fisheries in Pacific subsistence. M.Sc. thesis (unpublished), Dept of Geography, University of Cambridge, UK, 29 p.

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